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SCIENCE FOR ALL*

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Science has many possibilities as yet unexplored and not used. People need more experience in the field of science in order to react intelligently to the social and technological world. A check up will show only a small part of our people get enough science to react intelligently to the problems which they meet every day. When you speak to the ordinary individual about science he is likely to think of it as a field in itself. As a matter of fact science and the people's government are closely related. The National Society for the Study of Education made a very careful study of science in the American school. This report was published in February 1947.

"If all citizens are to participate intelligently in affairs of government, all need to know something about government. And if the people's representatives, who pass legislation, are to make decisions for an age of science, they need at least a reasonable knowledge of science and her ways of working. The ways of thinking of the politician and of the scientist have differed widely. Each group needs to understand and co-operate with the other. And the common man, if not a scientist, nonetheless needs knowledge of both science and legislation, since both profoundly affect his welfare."[1]

The United States needs a national program of education; there is also a need for a world program. The world program of education should be set up by the UNESCO. The objectives should be broad, general, and pointing in the direction in which society will move. In the United States a committee made up of representative citizens, businessmen, industrial leaders, professional men, social workers, and teachers should set up a broad general objective which should help direct education in the way it should go. Specialists in the field of

* Read before the General Science Section of the Central Association of Science and Mathematics Teachers, November 28, 1947.

[1] Science in the American Schools. Part I.

science or in any other field are generally too close to the field in which they work to set up the direction in which the work should move. Specialists are often very narrow minded. They have a single track mind. That is what makes them valuable and what makes them specialists. For this reason people a little farther away should set up the general objectives. Another quotation from the National Society for the Study of Education:

"Most American scientists probably regard it as their main obligation to make substantial contributions to demonstrate knowledge within specialized fields. A secondary duty is to instruct and guide their science students. Usually, if they accept it at all, they regard lightly or intermittently the duty to ally themselves with public affairs in which their scientific attainments and attitudes may help. The world-wide developments of the last decade make it imperative that scientists change this attitude of aloofness from the essential affairs of the common citizen. Scientists may help to guide public thought, action, and legislation. If they do not, thinking, acting, and legislating will proceed anyway. The scientists may have a part in developing the on-coming cooperation on social responsibilities. His absence will not prevent the movement but will deprive it of his valuable help. He should not forget that he, too, is a citizen, expecting and claiming his privileges and benefits as a citizen."

The Progressive Education Association reports objectives as follows:

1. The statement of objectives should be practical for the classroom teacher.

2. The objectives should be psychologically sound, that is, they should be based on general accepted principles of learning and should be subjected as little as possible to the conflicting theories.

3. The objectives should be possible of attainment under favorable circumstances. A teacher in an ordinary classroom with the average group of pupils should be able to bring about progress towards the attainment of these objectives.

4. The objectives should be universal in a democratic society.

5. These objectives should produce desired changes in human behavior which will make for a more happy life.

In the Forty-sixth Yearbook of the National Society for the Study of Education there is a discussion of twenty-six issues in the teaching of science. Number seven in this list discusses in some detail what should be the nature and function of the physical science course. Number eight in the same list raises this question: What is the place in the science curriculum of consumer education, conservation, aeronautics, physiology and health education?

It is not possible to set up an intelligent curriculum for the high school period without considering all the issues. Materials at one time were selected in terms of the subject matter field. The intelligent administrator picked his using a number of other criteria. The curriculum should be set up in terms of three important factors.

1. The dynamic philosophy of the nation. Or stated in other terms, the various social and technological problems of the day.

2. The curriculum must be set up in terms of the ability of the student and the stage of education which he is now in. That is, we would not give highly abstract material to a student with little ability. We would not introduce a senior course in the freshman year. The ability of the student and the stage of his development are important considerations when setting up a course of science.

3. What part will the school play in developing these objectives? It is possible that the school should be satisfied in its offering in the field of science today. Many people have the notion that the science field should be enriched and that young people need more experience in science than they are getting.

At the end of 1945 the United States entered a new era in world politics, science and industry. The end of the old world policies with the United States as a second or third rate power has passed out of the picture. We suddenly, without any planning our part, found ourselves as a world leader. What will we do with it? Will we blaze forth for a few generations and gradually use our strength and influence or will we grow into world leadership for many years. Nations, as a general rule, decay from within because of the lack of insight in their own problems. There is plenty of evidence in that history is full of such instances. Nation after nation has failed in its national life and lost its place in leadership because vigorous new nations do what this nation has failed to do.

When our people landed on the Atlantic Coast they organized a school program the first year. To this has been added gradually until we have one of the finest educational systems in the world. Our educational program is built on our democratic philosophy. Our technology was noticeably superior during the last World War. Our war machines were good, in fact they were better than any produced by any nation. Education must be credited with helping build such a powerful nation. Our program has been very good. An educational program is like an automobile or a radio or any production machine. It serves its purpose, must be outmoded and put in a museum each year. Technology has very little difficulty in placing its machinery where it belongs after it is outmoded. Education has a tendency to hang on to everything which it introduces. I suppose that Chicago has in some school or other every subject which has ever been introduced into the curriculum. There may be exceptions. If there are exceptions they are rare. Our secondary education program has served its purpose well. It could have served better but that is in the past. We are living in a new social and technological world. Our program should be revitalized, reorganized, and stated in terms of a 1950 social order.

The citizens of our great nation and of all other nations are lacking in two important fields of human experience. One, in the field of civic education, that is, education for civic responsibility; the other in the field of science and technology. We have not taught the American Way of Life as well as it should be taught, neither have we taught all of our people the scientific facts of life. There is plenty of evidence in our superstitions that science has not been effective in doing away with all of our limitations. About 1920 someone proposed in a series of papers that certain races were superior to all others. It took only ten years to develop that thesis and find someone who would capitalize on it. Hitler made use of this thesis in the superiority of the German people and the inferiority of the minority groups. We know the story. Where are we today on the same problems? We are doing many of the same things which he did. All science points to the fact that there is no such thing as a racial superiority and the anthropologists have plenty of evidence to indicate this general direction. Yet, we in our science classes have not been able to develop this notion. Why?

In order to make place for new offerings in the secondary school program it is necessary to review the areas of human experience which are necessary in the secondary school field. There are four areas which are more or less overlapping and which should be considered in setting up a secondary school program. They are as follows:

1. A study of the finer things of life which we often call appreciation. This is illustrated by the work in art, literature, and music. In this great field we have the acceptance of human values.

2. One of the most important fields at the present time is in civic responsibility. We need to develop an understanding of people and the relationship with others. If we wish the American way of life to find a place in world of nations in the way that it should, we must build for a fair way of selecting this form of life. In other words, we need more human engineering. This is not the place to discuss this important topic but in making room for another topic the relative values must receive consideration.

3. The third general field is one of earning a living. There must be developed the fundamental skills, special abilities, and understandings which will enable a person to earn enough money for himself and to bring up his family. We cannot overlook the practical part of life and leave out the notion that the high school student must have some salable skills. We will include the so-called three "R's" and the various manipulations of appliances which have to do with manual arts.

4. There is the area which has to do with the building of an understanding and appreciation of the basic science which underlies human experience. There are a number of primary understandings found in the vast field of science which includes Botany, Zoology, Astronomy,

Geology, Anthropology, Physics, and Chemistry. For many years science has been a very valuable offering in our public schools. We have had very fine courses in at least four of the subjects, Botany, Zoology, Chemistry, and Physics. These courses have been given mainly for the college preparatory youth. They have been elective. Many students take these courses but many more never get into any of these. In many institutions Botany and Zoology have been reorganized into a Biology Course. The offering here is very attractive and many of our youth take this course. Not more than fifty percent of our students, however, come in contact with this course. The materials used in the Biology texts are very teachable. They are very valuable to youth. Probably all of our young people should be asked to take this course. In many of our schools the courses given in Chemistry and Physics represent a step down in college science. The same experiments given in college are used. The courses are mathematical in nature and are entirely too difficult and too narrow in scope to be required of all. The best of the high school teachers have made this material adaptable and brought it to the level of the average and above average student. This leaves, however, about fifty percent of our people having no contact whatever in the field of the physical sciences. We are living in a scientific world. We are going to continue to live in a world of science. Technology plays a very important part in our lives. We may take one of two positions. We may say let the few scientists develop and keep in repair the various gadgets which we use, or we may say, let us all take part in this interesting phase of life. There are so many interesting instances which young people can have in the field of Chemistry and Physics that it is too bad that we let them go through high school, come out as graduates and know little or nothing about either of these fields. There should be provision made to take care of young people. We have tried the elective system long enough to know that this plan is not effective. A committee of educators along with representative citizens should set up the courses which are required. These courses should be based on the interests of young people at the age in which they are offered. If a subject cannot be made interesting to a sixteen year old, he should not be asked to take it. The work done at any given age should be of interest to that age. The old notion of adult values should be at least put in second position and not first. I do not believe in permitting youth to take only that which they are interested in but on the contrary nothing should be required of them which cannot be made interesting to them. These may seem like conflicting statements but they are not.

Today general science is the only science required of all of our students in Chicago schools. Teachers of general science are doing a

fine piece of work but they are trying to do the impossible. It is not possible in one year to teach effectively the many fine things that are found in the general science textbook. It would be much better if some other organization were set up and at least one year more of science required of all young people. In order to make a place for more science, I wish to offer the following aims and objectives:

1. Science should be developed to build an understanding and an appreciation of man and his world.

2. Science should be taught to help do away with the many superstitions which have been used to explain many of the hazardous things which happen. You may say, "Well that discussion is obsolete." However, a few years ago one of the teachers in Columbia University made a careful study of the many superstitions which are found with ordinary folks. It's surprising when we study this list to see what educated people believe. The many superstitutions which have been set forth concerning the Atomic Bomb in the past few months might serve as a good example. We are a nation of unfortunate people when explaining scientific phenomena.

3. Biology has done much to build up an understanding of plant and animal development. It can do more.

4. The foundation of health practices should be well established in the field of the Biological and the Physical Sciences. We are not making progress as fast as we should do in the field of health. In Chicago we have not moved fast enough to put health education, except in a very limited way, in our public schools. The high schools have no health service at all except by certain appointments and the elementary schools have a very limited form. The school is no doubt the place to build up the correct notion towards health.

5. To develop an understanding of human development. The development of the Atomic Bomb startled the world to recognize the fact that science has a number of possibilities and that our research has not reached the end. Our recent advances in machines, which have to do with production, communication, and transportation, places us in a position to be ready to give a minimum of science to the masses. An understanding and appreciation of the machine age is extremely valuable. We cannot live in an age when new machines with a new type of energy and not take most of the people along. These basic understandings are not for the few, for the few college graduates but for all. China is an outstanding example of a people who have made much progress in the field of human relations and practically no advance in the field of technology and science. Their production, transportation, and communicating facilities are almost zero. As a result their standard of living is on a very low level. They cannot produce food, clothing and other conveniences which their people should have.

Not only this, they are not able to protect themselves from other nations. Good will among people is not a very effective defense from a nation such as Japan. Their lack of technology has left them at the mercy of unscrupulous nations. We, as a nation, should develop both the science of technology and human relations. Much remains to be done in both.

"Americans, one might say, are just beginning to take their science and technology seriously. Ever since the depression of the thirties, we have been steadily losing some of our naive ideas. The bomb-burst on Hiroshima just about completed the destruction of whatever illusions were left over from the depression and the war. We are, as a people, now faced with the job of growing up, and quickly, for the full awfulness of the destructive potentialities of our science and technology has been laid bare during the World War II for all to see and contemplate.

"Nothing less than a full facing of the facts and the trends they forecast will do. Among all the 'musts' we face today, an understanding of the tremendous significance of our science and technology with respect to our social, political, and economic life, and to peace, surely stands near the top. It is to this task of trying to understand the importance of some of the facts and problems of our thoroughly technologically oriented society that we as professional people interested in the secondary school should address ourselves."[2]

What should be done?

1. Set up two required courses for all high school students. Require all freshmen to take the course which is now called Biology, and organize a new course in the physical sciences which will be required in the second year. Schools offering specialized courses in Botany, Zoology, Chemistry, and Physics would offer these in the upper years. They should be built on the two years of required science. If students were sure that they were going to take the year course in Chemistry and Physics, they might be excused from the year of the physical sciences. However, it would probably be better administration to require all to take the two years of required science and build the other courses with that in mind.

2. What should be the content of the second year of required science? Select from the field of Chemistry and Physics a number of basic concepts which would explain the experience needed in a scientific world. The concepts should be important and they should be teachable. The experiences should be within the range of the student taught. Only the simple mathematical concepts should be used. Keep in mind the fact that science is for the purpose of helping understand a situation. As yet there is no body of material suitable for second year students in the physical sciences. There are plenty of people able to reduce this material if their time were made available so that they could set up this course. The production of material should be carried on through cooperative effort possibly with the National Principals

[2] *Secondary School Principals Bulletin* No. 149.

Organization. If a commission were set up to produce such material it would not be long until this would be available.

It has been often asked what will happen to the general science teachers when such courses are offered? General science teachers are now trying to teach the four sciences. Most of them would be used in the first year science as now suggested. It would not take very much more ability to handle the course in Biology than it takes to handle the course in general science. If there happens to be some shortage of experience, teachers could be given a little time in order to qualify according to the standards. In the case of new courses, teachers must adjust themselves to the new situation.

Conclusion

Science is one of the most important phases in general education. It must be made available and it must be required of all future citizens. It must be reorganized in terms of its practical application. The scientific mathematical methods of the past are not of fundamental importance except to the very few. There are so many situations in general understanding that it is well worth the time to organize such a course. The teachers in Chemistry and Physics would need to adjust their offering in keeping with what is found in the new required course. While the course is being organized students planning to take both Chemistry and Physics, might be excused from the required course. The relation of people to science must be part of the work done by the teachers. Our schools have done a fine job for the few. It is now time to set up and organize our courses for the many. Our schools have done a very fine job but they can do better. The pattern of the modern high school must be changed. A new program in keeping with what has been done, must be set up. We have organized great programs in the past. We must continue in the same general direction. Courses have been organized for the purpose of making good college students. Let us change the pattern and organize so as to make not only good college students but make good citizens of the others. Science is a part of our social experience. Let us plan to show that all may have a chance. I wish to close with the following quotation:

"Science is today on a plane of high significance and importance. It is no longer, if indeed it ever was, a mysterious and occult hocus pocus to be known only to a select few. It touches, influences, and molds the lives of every living thing. Science teachers have a great opportunity and responsibility to make a large contribution to the welfare and advancement of humanity. The intellectual aspects of this responsibility are at least coequal in importance with the material. Science is a great social force as well as a method of investigation. The understanding and acceptance of these facts and this point of view and their implementation in practice will, more than anything else, make science teaching what it can and should be."[3]

[3] *Science Education in American School*, 46th Yearbook, Part I, N.S.S.E.

UTILIZING THE EARTH*

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The laboratory of the geographer is outdoors; it is the surface of the earth itself. The geographer attempts to understand the resources of the earth and the patterns of their distribution and utilization by mankind. He attempts to understand the place setting of human activities just as the historian attempts to understand the time setting.

What are the total resources which man can utilize to gain a living and build civilizations? There is no simple quantitative answer to this question because resources are meaningless unless considered in terms of the economic conditions and technological tools which man possesses at any given time and place. Neither the iron ores of Minnesota nor the water power of the Columbia River were resources to the Indians, nor the coal of England or Germany, resources to the Europeans until the last few centuries. Iron ore or coal resources of similar richness and potential water power of even greater dimensions exist today unutilized because of a different areal setting—such as location far from potential markets or existing facilities.

The key resources are those which make possible food production, for without food we would perish quickly. Therefore let us first survey the agricultural potentialities of the earth. But let us not confine ourselves to agriculture because man does not live by bread alone and indeed the production of bread entails much besides agriculture.

AGRICULTURE

An Historical Note. Since we often fall into the error of assuming that resources are static, I wish to say something about the development of agricultural resources since the time of Malthus in order to help emphasize the dynamic nature of man's utilization and appraisal of resources.

Malthus, you will recall, was a rather pessimistic student of population at about the beginning of the 19th Century. He theorized that population would increase up to the very limit of subsistence and be limited only by the amount of food available and be checked by actual starvation, malnutrition, war, and disease. Malthus was not out of touch with his times, for students of the day could not envisage the resources for an expansion of population at that time. It had been discovered that nitrogen was being continually lost from the soil through plants. No method of replacing this lost nitrogen on a commercial scale was then known. Prophets of gloom therefore pre-

* Talk before the Geography Section of the Central Association of Science and Mathematics Teachers, November 28, 1947.

dicted that as the nitrogen of the soil was gradually depleted the carrying capacity of the land would diminish and the population-supporting capacity of the world decline. This impoverishment of the then-cultivated lands could not, it was thought, be offset by new lands, since the lands known to be cultivable were then largely under cultivation. The grasslands of Australia, Argentina, the United States, Canada, Hungary, and Russia were not thought capable of supporting arable agriculture.

These gloomy predictions did not materialize. As science and technology marched on, the yields in the old lands were increased and vast tracts of new agricultural land were opened up.

Continued use, indeed intensified use, of the old lands was made possible by many scientific developments. It was discovered that the vital nitrogen could be replaced in the soil (1) by the planting of leguminous plants which had on their roots bacteria-containing nodules in which atmospheric nitrogen was fixed, i.e. combined with other elements, (2) by the utilization of sodium nitrate from Chile, which was introduced into England about 1830, just before the death of Malthus, and (3) by the chemical fixing of atmospheric nitrogen and the synthesizing of nitrogen compounds for use as fertilizer. The ghost of a nitrogen famine was buried.

By the use of other fertilizers, by the development of new crops, by selection of higher-yielding strains, and by improved methods, crop yields made remarkable increases. In England, for example, the yield of wheat, instead of declining, rose from 10 to 30 bushels per acre. The introduction of root crops such as turnips and swedes for use as winter fodder is said to have doubled the livestock-carrying capacity of British farmlands, that is, each square mile could support twice as many cattle as previously. Without any increase in land area or any change in the inherent physical characteristics of the land, it had assumed a greater resource value for man as his technology changed. Similar changes took place in other countries, particularly in Germany.

Just as striking as the increased intensity of agricultural production in the older lands was the actual areal extension of farmlands into the great grasslands of the earth: the prairies from Texas through Kansas to the Dakotas and Saskatchewan and Alberta, the pampas of Argentina, the southeastern grasslands of Australia, the Hungarian plain, and the steppes of the Ukraine and Russia. The factors which made possible the spread of cultivation onto these new lands were many but among the factors were the following: development of well-drilling equipment, the roller milling process, agricultural machinery, railroads, new strains of wheat, and the rise of markets for wheat in the industrialized urbanized countries of Western Europe, particularly

Britain. The grasslands were dry lands—not moist enough for forest growth. Streams were widely spaced and the water table usually was fairly deep. Farms were so widely spaced that each required a separate well. The time-honored method of hand digging simply could not reach the water table economically; water for man and beast therefore awaited the development of a well-drilling technique. In the dry grasslands the yield of wheat is less than in the humid forested areas and each farmer, in order to get enough of a crop to support himself and his family, must cultivate a much larger area—an area larger than he can by hand. Thus agricultural machinery becomes a necessary tool for the successful cultivation of the land, because it makes possible the cultivation by one man of an area large enough to support a family even though the yield per acre is very low. Opening of the grasslands therefore awaited modern agricultural machinery. But to use such machinery the farmer must be able to pay for it by a surplus of crops to be sold off the farm to distant markets. Until the coming of the railroad wheat simply could not be moved the thousands of miles to consuming markets. The invention and building of railroads was therefore a necessary step in the opening of the grasslands. The rise of the market for commercial wheat associated with the Industrial Revolution in Britain also played an important role. Then there is the story of the development of strains of wheat adapted to the semiarid climate of the grasslands. In the United States this is partly the story of the carrying of suitable seed wheat by Mennonite immigrants from Russia and the later selection and collection by seed specialists of the Department of Agriculture.

Thus the gloomy predictions current in Britain at the time of Malthus were not immediately fulfilled. New techniques greatly increased the resource value of known agricultural lands; new techniques opened the grasslands, which were occupied quickly. The population increased rapidly and the people enjoyed a higher and higher standard of living with better diets and less disease. Indeed production at times outran consumption, resulting in serious overproduction (at least locally), crises in marketing, low prices, and serious depressions for the farmers.

The Present Outlook. This is an appropriate time to take stock once more. Are we on the threshold of a new period of increased capacity to utilize our agricultural resources or is the world now likely to degenerate slowly but inevitably to the bare subsistence levels of the Orient? The trend of population growth in Western Europe, the British Dominions, and the United States indicates the approach of population stability well within the producing capacities of these areas. Population in Eastern Europe and the Soviet Union, however, is increasing rapidly and is putting increasingly serious pressure on

the food supplies in those areas. It is possible that within a few decades the pressure on the food resources in those areas may approach that in China and India. The question thus arises "Are there new agricultural frontiers today comparable to the grasslands of the 19th Century?"

The land surface of the world may be divided into four roughly equal parts, one of which is too cool for extensive agriculture in the open, one of which is too dry for regular farming, one of which though warm and moist enough is too rough or has too poor soil, and one of which is apparently suitable for cultivation. The land surface of the world is about 58 million square miles. About 10 million square miles lie on the poleward side of the mean isotherm of 50° for the warmest month—the isotherm that marks the coldward limit of tree growth and is far beyond the cold limit of most crops since few crops grow much when the mean temperature is below 50° Fahrenheit (10° Centigrade). About another 5 million square miles lie in the northern parts of the cold coniferous forestlands of North America and Eurasia in regions of very little agricultural promise because of a bad combination of short, cool growing season, poor acidic soils, and poor drainage. The dry lands are not quite as extensive as the cool lands, amounting to 13–14 million square miles instead of 15 million. Commercial crops do not grow without irrigation in areas of less than 8 inches of rainfall in cool lands such as Canada, 12 inches of rainfall in warm lands such as Kansas, or 18 inches of rainfall in hot lands such as India; these then are the barren dry lands. The estimation of the areas of rough topography and poor soil is more difficult but in the old lands of Europe, where there has been strong pressure on the land for centuries, only about half the land climatically suited for crops is actually under cultivation; the rest is rough in terrain or poor in soil. Applying this ratio to other parts of the world, one could count on half the land climatically suited to crops being not suitable because of topography or soil; since half the land of the world is climatically suited, one quarter of the total land area is ruled out for topography or soil and only one quarter remains. Some inroads will be made on each of the other quarters but they hold only slight promise. Are there areas within the potential quarter not now utilized? Yes, there are. Within the equatorial regions are large areas with adequate rainfall and temperature not presently utilized. In Java, the only large densely settled agricultural area near the equator, there are 40 million people on 50,000 square miles. There are approximately the same number of people in Brazil with an area of 3 million square miles, or 60 times as large. In 3 million square miles in Equatorial Africa there are only 20 million people. If either Equatorial Africa *or* Brazil were as densely settled as Java it would support all

the people in the world! Is there any possibility that either Africa or Brazil can become as densely settled as Java even though their equatorial sections today are very sparsely settled? The answer to this question is unknown. It is the great question of settlement in the 20th Century and perhaps the 21st Century, just as the settlement of the grasslands was the great question of the 19th. Java is unusually fortunate with an excellent combination of rich soil, good climate, industrious inhabitants, and many other resources. Neither Brazil nor Central Africa appear as favored. Poor soil seems to be the most significant limiting factor, though disease, drainage, heat, and other factors pose problems. Perhaps science and technology will open these lands to settlement but there can be no certainty of this at the present time.

Manufacturing

One might well question why I should wish to talk about manufacturing in a discussion of the utilization of the earth. I do it because our economy and civilization is not exclusively agricultural. Indeed agriculture itself leans very heavily on manufacturing for its own utilization of earth resources for without agricultural machinery, well-drilling machinery, railroads, and urban markets, the wheatlands of the grasslands would be little utilized. Furthermore our whole economy is now dominated by nonfood items. Food accounts for only about 20% of the budget in many segments of America, though about 75% in some Oriental areas. Thus the capacity of the earth to support population depends not only on agricultural resources but also on other segments of the economy, from which manufacturing is selected for more detailed analysis. Machinery, a product of manufacturing, makes possible our energy economy, in which each person in the United States has 100 inanimate slaves compared to but 1 for each person in India or China. Transportation, made possible by modern manufacturing, moves goods a hundred times as fast in airplanes as on foot, and a thousand times as cheaply in steamships as on human porters.

Manufacturing is highly localized. The two great manufacturing belts of Northeastern North America and Western Europe occupy only 1% of the land surface of the world and within these belts only about 1% of the land is occupied by cities, railroads, factories, mines, and similar human structures. Thus the key urban and industrial areas of the world occupy only 1/10,000th of the surface. This may be illustrated by the women's clothing industry. A typical farm in the Dakotas, of 200 acres, supports about 5 people. An area of the same size—200 acres—south of Times Square in New York supports 150,000 workers in the women's clothing industry and produces half the women's clothing worn in the United States.

Just as agricultural land use has undergone transformation during the last century, so has industrial land use. The location of the major industries has changed notably. The iron industry, for example has moved westward from New England to Eastern Pennsylvania, to Western Pennsylvania iron ores, to Eastern Pennsylvania anthracite, to Western Pennslyvania coking coals, and in part recently to markets. The textile industries have migrated outward from England to Japan, India, and Brazil and from New England to the Carolinas. Is it then possible that industry may move from the present highly localized centers to a more uniform distribution over the face of the earth? Some migrations are certain but any account must discriminate among four types of industry: (1) raw material industries closely tied to areas of production of the raw materials since the manufacturing process results in a decrease in bulk or perishability (cotton ginning, concentrating of ores, sawing of lumber, canning of fruits and vegetables); such industries are now dispersed and are likely to remain so, (2) market industries resulting in an increase of bulk or perishability (ice cream, ice, bread, soft drinks), now dispersed among markets and likely to remain so, (3) power-tied industries now on coal fields or sources of hydroelectric power, likely to remain near such sources or newly developed ones, and (4) complex manufactures now the most sharply localized but likely to be characterized by some dispersion.

What can we conclude from these diverse remarks about the utilization of the earth? (1) The pattern of resource utilization is not uniform in space but is highly varied, both the agricultural and industrial activities being highly localized on a relatively small portion of the earth's surface. (2) The pattern of resource utilization has varied greatly in time, changing rapidly during the last century, for example, and promising to change further during the next. (3) Agriculture and manufacturing are not independent methods of resource utilization but each depends on the other.

A NEW HEALTH FILM

According to an announcement made this month, Young American Films, Inc., has been appointed as the exclusive sales agent in the United States and Canada for MODERN GUIDE TO HEALTH, a new one-reel educational film just received from Great Britain. MODERN GUIDE TO HEALTH is a cartoon-type film dealing with such health problems as posture, care and selection of clothing, and the importance of rest and sleep. It is a sound film, in black-and-white, running approximately ten minutes. It is aimed at parents and other adult groups, but is regarded as having high value for school audiences. MODERN GUIDE TO HEALTH will be available through all Young America Films dealers. Sale price—$38.50.

YEARBOOKS AND SCIENCE EDUCATION

E. LAURENCE PALMER
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The subject of this talk was selected by the Chairman of this meeting from a number submitted to him. Selection of this topic by the Chairman was conditioned by me on the assurance that I should be representing no one but myself in the matter. If there should be any adverse criticisms, I wish to assume full responsibility for them, with certain minor reservations.

On June 12, 1947, about three weeks before he died Dr. Otis Caldwell wrote me regarding a proposed review on one of the current yearbooks. He wrote, "Your statements would of course be based upon what you think are the real facts." And again, in the same letter, we find "Your review will have better reception if it is prepared on a strictly factual basis." He closes with this last sentence he ever wrote me, "Please go 'all out' in stating the facts as you believe them to be." Earlier in the letter, he asks me not to withhold any criticisms I might wish to make of his own chapters of the volume but adds that other members of the committee revised and supplemented the material in his chapters. He assumes certain responsibility for the whole yearbook when he writes that "all members of the committee read and assisted in revising and supplementing the materials which the initial group had blocked out."

I quote the above since it gives a part of the picture of how at least one yearbook has been prepared and because it indicates that at least one member of the committee that prepared the latest yearbook in this field approved a frankly critical review. Last week, another person associated with the production of this recent book wrote expressing the belief that there was a need "to offset those who would make science teaching an appendage of sociology." It is in part in the spirit suggested by these two that the following review of the yearbook situation is written. Now, as Al Smith, the finest man outside the Republican party used to say, "let's look at the record" even though he was just paraphrasing the Bible's idea that by their works ye shall judge them.

Before going into a detailed examination of the yearbooks that have been concerned with science teaching, let's define our problem by mentioning the yearbooks to be considered. Then, let us notice what the function of a yearbook might well be, and what trends or changes if any have been recorded in a number of them. We will follow this by an examination of the important things left undone by the yearbook writers and conclude with a summary of some of the evi-

dence we have that they may or may not have made a contribution to science education.

I must state again that I appreciate thoroughly that the responsibility for statements here made are mine alone. If I am wrong, I realize that I am hurting no one worse than myself. If I am right, I should like to have credit for having some sort of courage which seems to be lacking among some other reviewers of these yearbooks. There are plenty of yes men in professional science education who will praise anything they see in print. I am forced to be outspoken in my comments by my desire to maintain the respect of my associates in academic science and by my hope that professional education may through my comments be entitled to a greater respect than it sometimes gets, justly or otherwise. That I have faith in professional education may be evidenced by the fact that for twenty-eight years I have been a professor of education. To me, a yearbook in science education should be a volume that I would gladly take to any scientist or educator and say with pride, "This represents the best thinking and accomplishments in the professional field in which I have chosen to make my living." I can not honestly do this with the current yearbooks in that field. This paper hopes to explain frankly and honestly why.

The yearbooks here considered are the third, the thirty-first and the forty-sixth yearbooks of the National Society for the Study of Education. We shall omit consideration of reports of the yearbook type issued by the Department of Superintendents of the National Education Association, by the Department of Rural Education of The National Education Association, by the American Nature Association, by the American Nature Study Society and by the National Science Teachers Association. I am sure that any fair-minded individual will recognize the great professional influence of the series of yearbooks issued by the National Society for the Study of Education and the consequent responsibility they assume. Since that society has published the most recent yearbook in this field it is only natural that this series should come in for major consideration here.

According to the dictionary a yearbook is any summary of the facts of a year prepared essentially as a reference. Presumably, yearbooks by different societies might present different facts if they represented the viewpoints of the different sponsoring groups but they would have to agree on basic realities.

It would seem that, to be most useful, a yearbook should present a representative picture of a situation rather than attempt to "blow up" one viewpoint held by a limited group. A yearbook might best be honest, impersonal, timely, consistent, useful and adequate to fulfill the function for which it was prepared. An administrator or a teacher

of science or of some other subject has the right to expect of a yearbook in science education that he will find an unbiased picture of what is going on in science education, that there will be no effort made to gloss over weaknesses in the field and that the final product represents the best judgment of the responsible group as to the current situation in professional Science Education. I hope for the good of the committee that issued the last yearbook that they do not contend that it represents their best judgment. I doubt if the thirty-first and the forty-sixth yearbooks are representative of the best thinking in science education. I hope they are not.

Above all things, it seems to me that a yearbook in any given field should add dignity to the field it represents and should simplify the task of workers in that field. It should raise workers in that field in the esteem of intelligent workers in related fields. It should be able, with credit, to withstand an honest, critical analysis of its methods and findings and as the years go by one yearbook should show progress over what has been presented in previous yearbooks. It should present the latest developments in the field represented particularly where those developments have not found expression in everyday practice. I feel that the forty-sixth yearbook of the National Society for the Study of Education has failed to qualify on any of the points raised in this paragraph. I hope to show why I have come to this considered decision. In part, because of Dr. Caldwell's admonition to be specific, I shall refrain from too much abstraction.

When the thirty-first yearbook was published in 1932, I called attention to fundamental errors which I felt occurred there. I did this in print, personally to the committee, and at professional meetings. Apparently, they paid not the slightest attention to my comments since identical errors appear in the forty-sixth yearbook. I wish to state at this time that if I am alive when the sixtieth yearbook appears and it is published by the same committee and they make the same errors I shall again register my protest as effectively as I can. I know that some who will read what immediately follows will say, "Well, here he goes again," but I intend to keep harping on what I think is intellectual dishonesty until I get some indication that my suggestions have been heeded. Unfortunately, I must repeat here what I have said before but I can't help it.

One of the fundamental things in science it seems to me is that *valid conclusions cannot possibly be reached through the use of invalid data collected by the use of invalid instruments of measurement.* Unless you can agree with me on this, you are entitled to refrain from following me farther.

In 1924, A. Dvorak published a general science test. I understand it was prepared as a doctorate thesis in the School of Education of

the University of Minnesota. I also understand that Dr. Dvorak was awarded membership in Sigma Xi for its preparation. It should have been good. Let's look it over.

Each of the forms presents as an example of a good multiple choice statement, the following: "A fly is an animal, a fish, an insect, a reptile, a building." It does not ask one to choose which answer is the best but asks for the correct answer. Obviously, to me but apparently not to others, if a fly is an insect it must also be an animal since an insect is an animal. Therefore, either answer should be accepted though the only answer recorded as being correct is "insect." This unit is repeated as a type example at the beginning of every form of the set so it cannot be passed over as a bit of carelessness.

Now, if we are to agree with our testers that a fly is an insect, we run into difficulties when we attempt to answer unit 39 in the first form. Here, we find that one must answer the following: "Insects have the following number of pairs of wings: one, two, three, four, five." The only answer accepted is two so this means that the order of diptera characterized by having one pair of wings, and to which the flies belong cannot be insects even though the initial example insisted that they were.

We cannot review here completely the host of errors to be found in this test. It has been done before and is in print. But if we accept the only alternatives allowed in answering the test according to its producers all wounds should be dressed uniformly once a day, all wounds should uniformly be allowed to bleed "a little," mosquitoes in one's bedroom should be eliminated by going out and destroying the breeding places, the petals of flowers are colored but not the corolla, pistils, stamens and sepals, the age of trees can be told only by rings in the cross section, mosquitoes lay their eggs only in stagnant water, never in fresh water and one cannot legally use his eye-lids to regulate the amount of light that enters the eye. Furthermore, hair is not, according to this test, a distinguishing characteristic for mammals. Diamond in a paper presented in 1931 contended that 38 of the 180 units in this test were faulty because of inadequate recognition of the facts or for some other valid reason.

Now, why should I take time and space in an article on yearbooks to comment on a test that any qualified science teacher should throw out the window? I think I am entitled to use the recognition given this test by a yearbook committee as at least one measure of the worth of a yearbook that recognizes it as a valid instrument of measurement in science education. Interestingly enough the author, Dr. Dvorak, seems to recognize the real worth of the test better than others who have accepted it blindly as a useful measure of accomplishment in education. Now let's look at the record.

In 1924, Dr. Dvorak published the test which I am sure is still available. In 1924, Dr. Curtis, a member of the committees producing the thirty-first and the forty-sixth yearbooks, used this test as the instrument of measurement for getting data to use in his doctor's thesis at Columbia. In spite of this, he got the degree. In 1926, he published a digest of his study based on this test in the "Digest of Investigations in the Teaching of Science" edited by Dr. Powers who was also on both yearbook committees in one capacity or another. In 1929, Cunningham published an evaluation of science tests including a consideration of the Dvorak test and giving it apparently complete sanction. This annoyed me to the extent that I published in the same year the suggestion that one might recognize in writing science tests some obligation to stick to the facts of science. I published this warning in *The Nature and Science Education Review* which reached the majority of both committees and in *Childhood Education*. In 1931, Diamond completed a thesis showing the weaknesses in this and in other science tests and these were called to the attention of the committee members who later in the year published the thirty-first yearbook. In the appendix to that yearbook, I again called the attention of the readers to the use of this absurd test but there were at least ten places in that yearbook where studies based on that test were considered as valid. In 1932, I again called attention to this situation in *Science Education*. Still "no soap." In 1939, Dr. Noll listed the test as "one of the best available tests" in his book on the "Teaching of Science in the Elementary and Secondary Schools" and Dr. Noll is chairman of the committee responsible for the forty-sixth yearbook. In 1940, Dr. Curtis again recommends this test as a valid unit of measurement in his section of *The 1940 Mental Measurement Yearbook*. And now in 1947, we find studies based on this monstrosity given recognition at least on pages 59, 150, 176 and 180, of the forty-sixth yearbook. I have reason to believe that it will be recognized as valid in any subsequent yearbooks with which this group may be identified. I am waiting with bated breath their next offering in this line.

Frankly, I question the ability or maybe I should say the desire of these men to pass on the merit of science tests. Dr. Powers is credited in the introduction to the Dvorak test with supplying, with Dr. Glenn, the units that were used. In another test prepared by him, we find that flowers are the only recognized organs of reproduction of flowering plants thus eliminating the potato industry, that mosquito wrigglers are not fly larvae, that the seed probably is not a ripened ovule. To play safe, these same units are used in a biology test that appears under the authorship of Dr. Powers and Dr. Oakes. In this, we learn that deVries worked with primroses rather than with

evening primroses, that flies lay their eggs only in manure and that of the owls, English sparrow, kingbirds, woodpeckers and gulls, the woodpecker is the only one that consumes quantities of insect larvae. The most ridiculous unit in this series is the following which I have reason to believe few of this audience will be able to answer as is required to get a perfect grade. It reads as follows:

"In each group of five words below, four words are alike or related. Write on the line at the right the number of the one which is different from the others." I will not comment at length on the English of that sentence but I will ask you to make your decision on what is meant to be the misfit in the following list, which one presumably is unrelated to the others. "Bedbug, tomato worm, tussock moth, cabbage butterfly, silkworm." Obviously, all except the bedbug are members of the Lepidoptera but the only answer considered valid is silkworm an economically valuable species. Now, I ask you, how can I as a professor of education defend professional education to my associates in entomology if units such as these are considered as valid by professional educators? I'm not even going to try. When I called attention to the weaknesses in this particular test in 1929, Dr. Powers wrote me as of July 30 as follows: "May I assure you that we did go to considerable trouble to get the items, carefully criticized, and furthermore we used an extensive statistical procedure for evaluating each of the items on the basis of its usefulness for distinguishing between students rated on other measures as good or bad." In that letter, there was no recognition whatever of the fact that errors appeared in this test. This last test is not quoted as valid in the current yearbook but may be taken as similar to the Dvorak test that is considered valid.

I might write a whole paper on this test business but I cannot afford to do so. In it, I might call attention to a Maryland test strongly recommended by Dr. Caldwell formerly general secretary of the American Association for the Advancement of Science and a member of the forty-sixth yearbook committee. According to this test that is even worse than the Dvorak test, woodchucks gain protection for themselves by but one of the following methods, fighting, escaping, and by color, and in another unit we find the earth listed as the center of the solar system. On page 10 of the forty-sixth yearbook, Dr. Caldwell states that "the itch" is caused by insects rather than by arachnids. This same error appears in the thirty-first yearbook of which Dr. Caldwell was not a committee member so it is quite possible that this was a unit that crept in when "all members of the committee read and assisted in revising and supplementing the materials which the initial group had blocked out."

If the validity of other studies supported in these yearbooks is no

greater than that of the studies based on the Dvorak tests and other tests with which the committee has been identified then I contend that the yearbooks have little merit. If those involved would only once admit that they might have been mistaken my attitude would be radically different. But so long as they continue to defend these studies I shall continue to fight them if for no other reason then that I have faith in the integrity of education in general and because I believe that it can be placed on a level with work in academic science. If I did not believe this I should not have continued so long as a professor of education. Maybe I was mistaken in doing so but I do not believe it.

Now let's take another angle of the situation. In the thirty-first yearbook, the committee erected a straw man that they called nature study. They clothed it in the worst sort of ideas and then destroyed it and began to crow. It was not representative of the best in nature study nor did it recognize adequately the work of Jackman that was presented in the third yearbook of the National Society for the Study of Education in 1904. I have a letter from Dr. Caldwell dated March 24, 1932, in which he says: "I agree with you that it seemed quite unnecessary for the committee to make an attack on nature study teaching in the way in which it did in this book."

Since I have limited time at my disposal and since I have already published my evaluation of the attack on nature study in the thirty-first yearbook I choose at this time to consider primarily what the committee producing the forty-sixth yearbook considers traditional nature study to be. Since the word traditional which they use implies a long established pattern, it is difficult to recognize in nature study much that they allocate to that field on pages 42 and 43. What gripes me is the fact that in my judgment the very things that I have consistently criticized in the elementary science advocated by Drs. Craig and Meister, members of the committee, are now disparaged as being representative of nature study. I fail to find these qualities defended by Jackman of Chicago who wrote the third yearbook of the NSSE or by Bigelow of Columbia, or by Comstock or Bailey of Cornell. Let's look at this situation carefully.

To be consistent I must choose my major references from those quoted in the forty-sixth yearbook. For this reason only, I shall confine my search for illustrative material to Dr. Craig's doctorate thesis offered as a valid defense of the yearbook's philosophy at least on pages 73 and 83.

The forty-sixth yearbook committee contends that nature study should be criticized for its "practically exclusive use of exotic materials." The first real difference I ever had with Dr. Craig centered around his defense of the use of exotic materials in his program pre-

pared for use in the Horace Mann School in New York City. I objected to his teaching parental care in the elementary grades through calling attention to how the mother hippopotomus cares for her young on the River Nile and how the Columbia River salmon provides for the succeeding generation on the West Coast. I objected to lower grade elementary children studying what birds eat when south on their winter migration. One of the things that has always to my recollection characterized the philosophy of the American Nature Study Society leaders for the forty years I have known them has been their objection to the use of exotic materials. *There is no justification for that criticism coming from sources that have defended the use of exotic materials or from a committee that uses as a reference a study that emphasizes the use of exotic material.*

The committee takes offense at an implied defense of anthropomorphism and of teleology by the nature study field. Again, I do not know of any of the major nature leaders who have defended these devices as valid teaching techniques. It might be embarrassing at this point to call attention to the fact that on page 120 of the forty-sixth yearbook the committee recommends as a unit of study "How Plants Prepare for Winter." Isn't that teleology? Certainly, anyone familiar with Dr. Craig's thesis quoted in the study or with his texts will remember the great frequency with which he slips into this easiest of all traps which the careful science teacher must avoid. I confess that I have slipped into it myself a number of times and so I hesitate to criticize him in this connection. I do not however believe that either anthropomorphism or teleology are representative of traditional nature study. I do think that examples of this kind of technique are more frequently found in the writings of members of the committees who sponsored the forty-sixth yearbook. Someday, I may write an exhaustive report on this matter. It would be a simple matter.

The committee of the forty-sixth yearbook accuses nature study of using moral and religious interpretations of biological phenomena as a vehicle for good teaching. I must admit that I do not find examples of this sort of thing in elementary science. I do find it possibly in the writings of Schmucker and of Green but I do not find it as traditional among even the earliest defenders of the nature study idea.

I do not like to keep harping on this idea but I serve notice that as long as this or any group continues deliberately to misrepresent the fine nature study philosophy of Comstock and Bailey of Cornell, of Jackman of Chicago and of Bigelow of Columbia, I shall continue to fight back getting most of my ammunition from the published works of those who raise the objections. At present there is a sufficient backlog of ammunition to last through a long, long war. It serves no one any good to continue to erect straw men and then knock them down,

but if they want to get a howl from me there is no better way that I can suggest. It is not playing fair.

On page 43, the forty-sixth yearbook committee states that traditional nature study now "possesses chiefly historical interest since it is being replaced at an accelerated pace by the broader, more functional, and coherent program of elementary science." When true nature study goes out of elementary science, what do you have left? One of the reasons I have continued to defend the nature study philosophy is to avoid sanctioning the use of exotic materials and teleology so common in elementary science recommendations but more particularly to avoid sanctioning the wholesale use of material that is not scientifically true to the extent it is to be found in elementary science books bearing the names of members of the committee responsible for the forty-sixth yearbook. I regret the lack of time and opportunity to elaborate on this point at this time. It may be significant that the yearbooks avoid consideration of the value of current elementary science texts. Maybe there is a reason. I do not object to a mistake now and then. I make too many of them myself not to be charitable. But I can't be charitable about defending them indefinitely.

And, now we come to another and I think an even more dangerous part of the forty-sixth yearbook. As is the case with so~e of the points already raised what appears on the surface may not be representative of what the situation really is. If one did not take time to consider carefully the units in Dvorak's test he might say offhand that it must be good. Really, I assume that Dr. Curtis did not make such a critical examination of it when he used it in writing his thesis. I simply cannot believe that he did. Offhand, one might assume that elementary science did not recognize merit in teleology and anthropomorphism until he took time to examine with some care the chief representative works in that field. Similarly, offhand, one might approve the major recommendations in Chapter XVI on the Education of Science Teachers for Secondary Schools. I agree with the major recommendations of that chapter though I do not favor the recognition given survey and orientation courses nor do I feel that adequate training in the field of earth science is recommended. Nevertheless, I think that the recommendations in the forty-sixth yearbook are much less satisfactory than those in the thirty-first. As I figure it, according to the thirty-first yearbook, a junior high school teacher of science should have 60 hours of college science of which thirty-two should at least be regular courses in science, not profesionalized courses or orientation courses. Senior high school teachers of science must also according to the thirty-first yearbook have sixty hours of science of which forty apparently must be basic science work.

According to the forty-sixth yearbook, page 284, the junior high school teacher of science should have from "45–60 semester hours in science" while the senior high school teacher should have "a minimum total of 60 semester hours." Of these 60 hours, apparently 27 could be of the survey type leaving a basic 33 of the non integrated type. Frankly, I do not think that these recommendations are adequate and I think that there seems to be an unwarranted tendency to further recognize as valid the survey type of course as against the basic science course. I cannot go along with this trend but the committee has every right to hold to its beliefs. I will be satisfied if the day ever comes when all science teachers have the program recommended by the committee.

But now here is the funny part of this whole story. About a year ago, I had the opportunity to seek a college teacher capable of training science teachers. I assumed and still believe that a trainer of science teachers should know as much science as those whom he is training. I believe that I wrote to most of the members of the forty-sixth yearbook committee for recommendations. Here is what I got. One applicant trained under and recommended, I believe, by the sponsors of these requirements for high school science teachers had, according to the record sent me never had a college course in biology or in earth science. He had one course in physics and four courses in chemistry with some graduate work in chemistry. The candidate wrote that he was ready to serve "either in the capacity of a teacher or worker in an organization such as the United States Department of Agriculture which is dedicated to the improvement of an important area of our national life." His advisor who apparently gave him a doctorate in the field of science teaching wrote that "his experience and training make him well qualified for advancement in professional work in education. I expect he will take a leading position in the development of profession work in science education." The candidate himself felt qualified to teach science education at the college level or to serve in war reconstruction work particularly in agriculture. For any of this work, his chairman recommended him.

Another member of these yearbook committees trained another applicant for this position. When I looked over his application, I failed to find any record of his having taken any course in science at the undergraduate or graduate college level. Still he had a doctorate in science education and holds today an associate professorship in science education in a major university. I felt it only fair to write him and give him the opportunity to correct what seemed to me to be an obvious error. I have his answer before me in which he states: "Your questioning of my academic standing is well founded. Courses in geology, physics, chemistry, horticulture and ceramics were audited

in summer sessions, and while all were completed none received credit." This man wrote that he felt qualified to teach at the college level courses in "nature study, (hear-hear), physics, chemistry, biology, general science, geology and agriculture." One of his sponsors wrote, "He knows his subject and knows how to teach it. He is honest and never resorts to underhanded methods so often practiced by college teachers." I once sat beside the trainer of this man when a girl came up and asked what she should take to become a high school teacher of biology. When asked what she had had, she said that she had taken six hours of biology. With that, she was advised to take a course in curriculum construction to further her preparation to become a science teacher.

Another candidate for this position now prominent in science education fields had the following doubtful recommendations to which I gave due consideration in making my selection. One sponsor wrote that the man was "fearless in the espousal of causes in which he had been proven to be in error." Another wrote of him, "He seems rather cheerful and has plenty of self assurance. He had acquired some of the characteristics of the School of Education trained person, e.g., a willingness to undertake a task in a field in which his training has not been very thorough. He has no pronounced apparent sense of humor. I am certain he is honest and well meaning." I honor the school that had the integrity to send these comments regarding the qualifications of one of its candidates.

If I were asked to draw any conclusion from the recommendations to be found in the forty-sixth and thirty-first yearbooks and the type of person sponsors of these yearbooks are willing to recommend for college work in science education I would assume that *the higher you go in the field of science education the less need is there for adequate training in academic science.* Somehow, I think that the situation as a whole is a result of the application of such a philosophy though I do not find it stated in so many words in the recent yearbook. Maybe a yearbook should not present such a picture. Should it be necessary I have much more evidence to support these views and I assure you that the situation does not make it easy for me as a professor of education to defend professional educators before academic scientists whose judgments I respect. Because of this, so far as I am concerned, the yearbook has been a distinct disservice to education. Obviously, it is of no service value to science.

A week ago all the world glowed over the romance and wedding of a British princess. Society has set as a pattern for living happily ever afterwards with some one that we should love, honor and obey. Frankly, I doubt if the last admonition is necessary. No one has trouble getting along with those whom they like and honor. Under

such circumstances there is always, I believe, a willing cooperative effort.

I know of no leader in the field of science education whom I do not like personally. I know of no one in any field whom I can honor who is "persistent in the espousal of causes in which he has been proven to be in error." Frankly, I don't see how I can honor any group that persists in the defense of the merit of the Dvorak test whose author has himself admitted to me that it lacks the merit ascribed to it by others. One of the powers that be once told me that the only way he could explain my persistent criticism of the defense of fallacies was that I had some sort of disease. Apparently, the disease is not infectious so none of you need have any fears over the situation.

I really want to see education respected by scientists, and educators willing to abide by the philosophy of science. I honestly see no other way than keeping forever at trying to make work in science education sound. I don't believe defending studies based on an invalid instrument of measurement, the criticizing of nature study for having faults that can possibly better be ascribed to elementary science and the training of leaders of science teachers by giving them only courses in professional education is going to lead to any happy wedding between science and education. I do not expect any proposal of marriage from the yearbook committees. I defy anybody to take the Dvorak test to the head of any college department of botany, zoology or physics and point with pride to it as an example of what we are upholding in the field of science education. Persistent support of it in yearbooks like the thirty-first and forty-sixth can never gain respect for science education before critical scientists.

Now what might the yearbooks have done that they have not done? Between the appearance of the thirty-first and the forty-sixth yearbooks a whole lot of important things happened. Changes took place which find no recognition in the current yearbook. A protagonist of the thirty-first yearbook wrote an article to the effect that in a hundred years that publication would be looked back to as a milestone in progress in the field of science education. Shortly after, a German corporal started his armies westward with the assurance that what they did would shape the pattern of civilization for hundreds of years. The corporal has been put in his place but the job of doing it opened up whole new fields of progress in science practically none of which find a place in the new philosophy of science in the forty-sixth yearbook. About the time the German corporal got cocky, we in America put into power an equally cocky man who appeased and appeased again and again and again, who killed off little pigs and gave big pigs anything they cried for so long as they again voted him into power. Government has gone into the business of education in a way never

dreamed of when the thirty-first yearbook appeared. The patterns of science education are being framed for us and if we get a National Science Foundation they will be even more definitely set for us. Nothing of this important development appears in the pages of the forty-sixth yearbook. And yet those associated with its production are working themselves into positions where they can tell you what you must teach by subsidizing only those who teach the way they think one should teach. For all I know, you may have to use the Dvorak test to determine who shall get government subsidies and scholarships. The idea is not so absurd as it sounds.

We have made phenomenal progress in the use of the radio in education yet the section in the current yearbook pays no attention to the pioneer work in this field of Harry Carpenter or the program that I have carried on for eighteen years. It merely mentions a program that has been carried on for a relatively short time.

We have made stupendous gains in the field of conservation education and the yearbook not once mentions some of the more important progress made in that field. Over a hundred workshops in that field in the last year, conferences of a national nature again and again and all we get is a little statement that is wholly inadequate.

Nutrition problems have molded the thinking of every man and are shaping the economy of the world in a way that could not have been dreamed of when the thirty-first yearbook came out. The whole field of quick freezing has come into prominence with tremendously interesting lessons in science coming to the fore and we get a mere pittance of recognition of this development in the current yearbook.

We, in 1924 when the Dvorak test was published, used to go out and destroy breeding places when we wished to destroy mosquitoes. According to that test that was the only way you could get rid of a mosquito buzzing about your head in your bedroom. Between the appearance of the thirty-first and forty-sixth yearbooks, the whole story of insect control by use of DDT and its influence on biological balance has come into the picture. I think that a reader of a yearbook on science education should get some help on how to meet this situation at home and in the school. I don't believe it is given the recognition due it in the current yearbook. It would be much more valuable than much that is there included.

A few weeks ago I was asked by the editor of a children's encyclopedia whose policy in science I understand has been determined in part by one of the yearbook editors to prepare a unit on frogs and toads. I prepared it giving a picture of the kinds of frogs conspicuous in different parts of the country. I suggested variations in their calls and indicated how one could get records of many of these calls to help in learning of them. I suggested seasonal sequences and conservation

practices but I got the article returned. Here is the suggestion they made for improving my offering.

"Early in the spring you are likely to hear father bullfrog croaking. For bullfrogs come out early around most ponds and swampy lands. 'B rr-ump' it croaks in a deep tone. It is calling for a mate." I refused to write in the style which apparently is what the elementary sciencer is seeking. In the first place bullfrogs do not appear early in the spring. In the second, I doubt if there are many youngsters who have to have their sex education pampered by speaking of the male as a father. I am sure that bullfrogs are not ordinarily denizens of swampy lands in the strictest sense of what a swamp is. And I am not certain that the call of a male frog is "for a mate" rather than to warn away rival males. I could go on with this but it should be unnecessary. Rather I should prefer to demonstrate to you some progress we have made in teaching youngsters and others about such interesting things as frog calls. (Record demonstration.) Similar records have been prepared for bird songs and all of these should be useful to science teachers. All have been developed between the appearance of the thirty-first and forty-sixth yearbooks and none have been mentioned in the forty-sixth. Possibly some of you may say that this sort of thing is just nonsense, that it is not important, that it is just nature study. Well, during the war the army recognized sufficient merit in the matter to sponsor the making of a library of the noises to be heard in the tropics at night. This was done with the thought that such a library would be useful in teaching soldiers to interpret intelligently what they heard at night. We may think that we can laugh off another war but I doubt if we can and I am sure that anything directed towards making most of our population at home in the open at any time of year will be a good investment in lives. I wish I might develop this story farther but there is not time to do so.

I look in vain in the forty-sixth yearbook for adequate recognition of the opportunities and developments associated with the growth of the camping movement. Science is being and will be taught in the camping situation to an increasing degree but our yearbook committees are still harping away on their old generalizations and on their studies based on Dvorak. I wish we could let them sleep but we can't. Science goes on even if science education sleeps. We must have a generation of young scientists alert to anything that may happen. A mistake in an atomic bomb laboratory and the end is spectacular and impersonal.

We are told in the forty-sixth yearbook that the material was read by the whole committee and approved by a majority. I take that statement seriously. I have tried the nature study method of investigating some of the suggestions made in the forty-sixth yearbook.

Somehow things don't come out as I assume they should. I am no good at guessing what the answer should be as any one would have to do in following that Dvorak test and others as well.

As an example let me ask you in your mind to try to follow these directions that appear on page 237. We are told there that these can be demonstrated with satisfaction before a class and that the committee profited by the suggestion that these demonstrations be made and remember that all the committee read and approved this. I doubt if the committee ever tried them and I think that you will agree with me. Here is what is suggested.

"A metal can on the demonstration table will be crumpled when it is closed and air is driven out of it. Why?" I have been unable to see how you can drive air out of a closed can but the book says you can so I leave it to you to try it.

This demonstration is to be followed by this one.

"Fill a piece of glass tubing (at least 32 inches long) with mercury. Invert it in a dish of mercury. Why doesn't the mercury run out of the tube into the dish?" I ask you why it doesn't. Every time I tried it by the nature study method that mercury comes out. In nature study, we have a somewhat similar experiment where we close one end of the tube and invert the open end in a dish of mercury and the mercury does not run out. Maybe that is what they meant. I would not know nor dare make an assumption for them. I would suggest that those who read and approve these directions try a little nature study now and then. It may help improve their techniques. I only hope that we don't get a generation of young scientists trained in education without adequate basic science before they go fooling with atomic bombs. Can we entrust science education in a dangerous atomic age to individuals who forget to close the end of a tube in a simple experiment in physics? We must have another type in places of influence. I doubt if the recent yearbooks in science education have contributed to improvement in this matter or that they have improved on the third year book published by the same organization in 1904. I am not optimistic about this paper helping much in the situation, but I just had to write it. You may use it as you see fit. If the thinking back of the forty-sixth yearbook represents elementary science, I would thank God for nature study even at the risk of being accused of "using moral and religious interpretations of biological phenomena" by even mentioning the Deity. Next year, if you are awake and with us, I will tell you the story of the Elementary Science Texts.

POSTSCRIPT: Since this report was made, the committee responsible for the forty-sixth yearbook has published a further report on its

own offering. On page 296 of the December, 1947, "Science Education," Dr. Noll, chairman of the committee writes: "The yearbook, is then, in fact a committee report. Every word in it was read by every member, discussed and criticized both through correspondence and in conference, revised, and read again. . . . Anyone, therefore, who might decide to assail the report had better reckon carefully on the desirability of an encounter in which he would probably find himself arrayed single-handed against the united front of a committee of six." To keep the record straight let it be said that the author of this critical analysis does not feel inclined to make any modification of his remarks in the face of this threat. If this technique employed by the committee is a demonstration of their understanding of the scientific method as applied to science education that is of course their privilege.

MAURICE E. KING

Maurice E. King, for many years a teacher of science at the Oak Park High School, died December 3, 1947 at the age of 56 after a short illness. He was a native of Michigan but came to Illinois early in life where he attended college and began his teaching career. He received the Bachelor of Arts degree from Wheaton College and later did graduate work at the University of Chicago. He had been a teacher at Oak Park, Illinois since 1921 and had previously taught at Freeport, Illinois. For many years he was an active member of the Central Association of Science and Mathematics Teachers.

C. B. READ REPLACES CHRISTOFFERSON

Mathematics Editor, H. C. Christofferson is now with our armed forces in Europe and his work will now be taken over by Prof. Cecil B. Read of the Department of Mathematics of the University of Wichita. For a number of years Mr. Read has been active in the Central Association of Science and Mathematics Teachers and has been one of our review editors of mathematics books. To many of our readers he needs no introduction. Address articles to Prof. Cecil B. Read, Head of the Department of Mathematics, University of Wichita, Wichita 6, Kansas.

Intelligence is the security of the Republic as ignorance is the upholding of monarchy. To insure ourselves against the disasters of war . . . we want education diffused. . . .

ULYSSES S. GRANT

DEMONSTRATIONS IN HIGH SCHOOL PHYSICS*

R. C. GRUBBS
Shortridge High School, Indianapolis, Indiana

Physics would be a very dull subject for the average high school student if we would take away the laboratory work and the demonstration equipment. No other science can be demonstrated so well by simple experiments. The number of laboratory experiments that can be done is necessarily limited. The demonstration supplements the laboratory work and gives the student experiences he could not otherwise get. The demonstration experiment will maintain interest and sell physics to students. Often the apparatus is best set up in the laboratory with student assistance. Groups of students may be interested in building or assembling the necessary parts. Every demonstration should stimulate interest, discussion and active thinking. It will make teaching more interesting and more enjoyable. The teacher's interest and enthusiasm is an important factor in successful teaching.

Simple demonstrations should not be neglected. After years of teaching we may feel that some principles are obvious and not worth the time or trouble required to set up the simple equipment. A diagram on the board is a poor substitute for a simple demonstration, although it may well be used in connection with it.

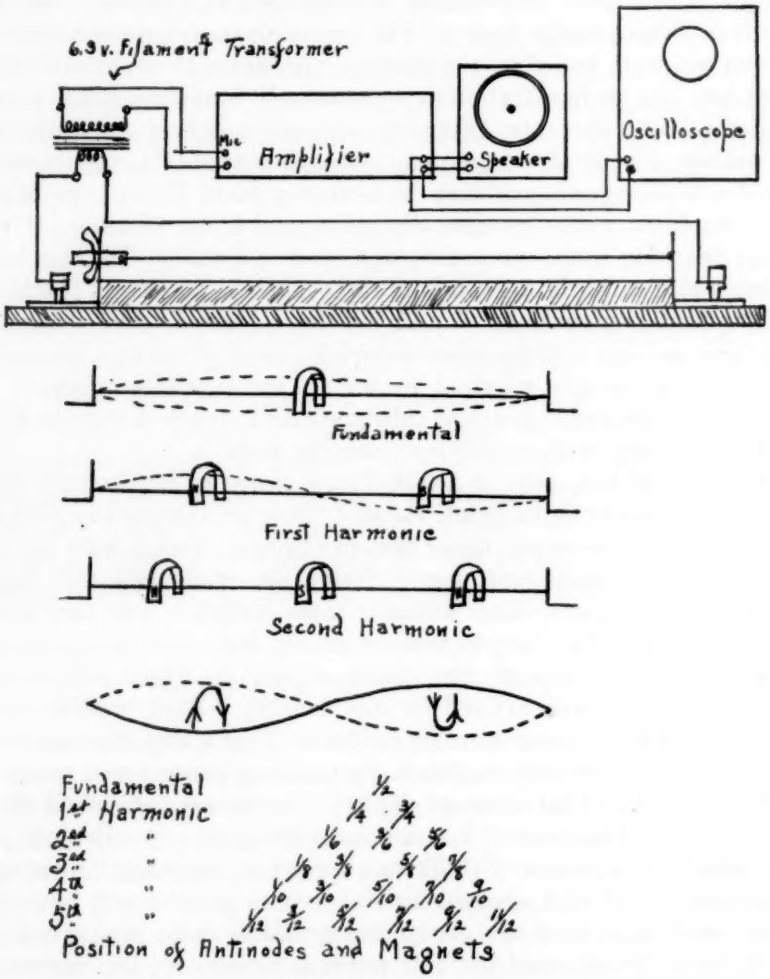
I can recall only part of a talk I once heard at a salesmeeting. I think the speaker had a point. He said "You are talking to a parade. Three million Americans never saw an elephant, that is why the circus will come back next year." "Same old stuff" you say—same stunts, same clowns, same animals, same ballyhoo you saw when you were a kid. Yes, largely true, of course, but since that same old elephant stalked through the streets a year ago three million new Americans will have arrived in this country,—three million more people who have never seen an elephant. That's why the same old elephant walks serenely confident that among every bored group of people who say "That's just an elephant" some eager voice will shout "Oh! that's an elephant." You are not talking to a grandstand, you are talking to a parade. I think this applies to teaching. The simple experiment that first aroused our interest in physics will have the same effect upon each new group that comes to us for instruction.

Students should participate as much as possible in the manipulation of the apparatus. If facilities are available they can often construct equipment themselves. They should be invited to make such use of it as they wish, often after regular school hours. There is little danger of damaging equipment in most cases.

* Read before the Physics Section of the Central Association of Science and Mathematics Teachers, November 28, 1947.

The cathode ray oscilloscope is a valuable piece of equipment, well worth the cost. It may be used as an indicator of numerous phenomena. It is not necessary for students to understand thoroughly its operation. It is an essential instrument in tuning a radio receiver and is particularly useful in studying sound.

A very useful device can easily be set up to demonstrate the overtones or harmonics of a vibrating string. It shows how the string



vibrates and indicates the relative frequency on the oscillograph. And the sound is audible through the speaker so that the change in pitch can be heard. A brass string is used on a simple sonometer. The ends of the string are connected to the 6.3 volt secondary of a small filament transformer. The primary is connected to the microphone input

of an audio amplifier. The output of the amplifier is connected to a speaker and to the oscilloscope.

When a small horseshoe magnet, alnico is desirable, is placed over the vibrating string at its midpoint, the induced alternating current produces the sound on the speaker and a wave is formed on the oscilloscope which is adjusted to show one wave form. If two magnets are placed over the string at the antinodes $\frac{1}{4}$ and $\frac{3}{4}$ the length of the string, the first harmonic will be heard and there will be two waves on the oscilloscope, since the frequency is twice that of the fundamental. It is possible to pick up the first 15 harmonics, perhaps more depending upon the length of the string and the size of the magnets.

This device can be used for many other purposes. The oscilloscope may be used to determine the relative frequencies of the string in verifying the effect of changes of length and tension on frequency. The scope may be adjusted for four waves at a known tension and length. The lengths can be adjusted to form 5, 6 and 8 waves while the tension is constant. Next the tension can be adjusted to give 5, 6 and 8 waves while the length remains constant. In each case we have ratios of lengths and tensions necessary for frequency ratios of 4, 5, 6 and 8.

This device may also be used to show that a current is induced when lines of force are cut by a moving conductor. A sine wave is formed on the oscilloscope. Increasing the tension on the string to increase its frequency or placing two magnets over the string will show that there is an increase in voltage with an increase in the number of lines of force cut per second.

THE DEVELOPMENT OF ANALYTIC GEOMETRY

RAYMOND A. KASSLER
Forest Hills, New York

Elementary geometry, as it is studied in high school, had already attained its present development at the time Euclid completed his monumental treatise, the *Elements*. Unfortunately, the geometrical methods in use then had failed when applied to the problem of the locus: a method of determining the assemblage of all possible points or curves. The locus problem was treated as a separate entity and isolated from other related problems. In fact, no general method was advanced for the solution of the locus problem. This was due to the fact that the definition of the word "locus" was fallaciously interpreted by ancient mathematicians. However, Réné Descartes conceived the locus as being the path of a point or a curve moving according to some law. In fact, he was the first mathematician to show that, if an algebraic equation defines the locus of a curve, then every point on the curve satisfies the given equation, and conversely, by assigning numerical values to points in space, Descartes was able to devise a plan for graphing an algebraic equation. In addition, the familiar coordinate axes were employed for the purpose of delineating the direction and position of a point in space with reverence to the origin of the coordinate system. Thus, analytic geometry has evolved from a marriage of algebra and geometry.

THE ELEMENTARY SCHOOL SCIENCE LIBRARY FOR 1946–1947

PAUL E. KAMBLY
University of Oregon, School of Education, Eugene, Oregon

This fourth list of reference books for elementary school science supplements the previous listings.[1] The sub-division topics, similar to those previously used, are of no significance except as an aid in grouping the references.

The grade levels indicated are the lowest in which it is recommended that the books be used. These recommendations and the brief annotations are based on an examination of each book listed. The prices indicated are subject to change.

REFERENCE BOOKS FOR ELEMENTARY SCHOOL SCIENCE

Ancient Animals

	Gr.	Price
Life Through the Ages. By Charles R. Knight. 66 pp. '46. Knopf*. The title indicates the nature of the content. Well written with excellent illustrations.	5	$2.00

Animals

(See also list of books on birds and insects)

Animal Hide and Seek. By Dahlov Ipcar. 30 pp. '47. Scott. A book filled with examples of animal camouflage. Large print with many illustrations.	2	1.50
Coyotes. By Wilfrid S. Bronson. 59 pp. '46. Harcourt. Written in 24-point type and well illustrated with drawings. A very interesting account of the lives of these animals.	2	1.75
Egg to Chick. By M. E. Selsam. 30 pp. '46. International. The changes that take place from the time an egg is laid until a chick hatches out. A good introduction to animal growth.	2	1.00
Turtles. By W. S. Bronson. 58 pp. '45. Harcourt. Written in 24-point type and well illustrated with drawings. The book includes information about keeping turtles as pets.	2	1.75
Goldfish. By H. S. Zim. 65 pp. '47. Morrow. All about goldfish—how they swim, what they eat, and how they breathe. Illustrated with drawings.	3	2.00
Hidden Animals. By M. E. Selsam. 30 pp. '47. International. A picture book in which animal camouflage is cleverly illustrated.	3	1.00
Little Creatures with Many Legs. By Charles H. Gable and E. S. Quillin. 48 pp. '44. Whitman. Stories about spiders, scorpions, centipedes, daddy longlegs, earthworms, and lizards.	3	.50
Animal Homes. By George F. Mason. 96 pp. '47. Morrow. The staff artist at the Museum of Natural History in New York has produced an excellent book about the places where animals live.	4	2.00

[1] Kambly, Paul E.: "The Elementary School Science Library," SCHOOL SCIENCE AND MATHEMATICS, 44: 756–767. November, 1944. "The Elementary School Science Library for 1944–45." SCHOOL SCIENCE AND MATHEMATICS, 46: 13–16. January, 1946. "The Elementary School Science Library for 1945–46." SCHOOL SCIENCE AND MATHEMATICS, 46: 865–870. December, 1946.

* Publishers and their addresses are listed at the end of this section.

	Gr.	Price
Mammals of North America. By V. H. Cahalane. 682 pp. '47. Macmillan	5	7.50
An excellent book on mammals written by the Chief Biologist of our national parks. The groups are logically arranged and the information about any mammal is easy to locate.		
Reptiles and Amphibians. By New York City Writers' Project. 253 pp. '39. Whitman	5	2.25
There are one-hundred twenty-five excellent photographs accompanied by accurate information.		
Who's Who in the Zoo. By New York City Writers' Project. 211 pp. '42. Whitman	5	2.00
Over 100 excellent photographs and descriptions. Includes only the mammals.		
The Wonder of Life. By M. I. Levine and J. H. Seligmann. 114 pp. '40. Simon	5	2.00
The story of how we are born and how we grow up. Essentially a book that should be given to the child.		
The Biggest Bear on Earth. By Harold McCracken. 114 pp. '43. Lippincott	6	2.50
A story of bears in the wild tundra country of the Alaska Penninsula.		
The Last of The Sea Otters. By Harold McCracken. 99 pp. '43. Lippincott	6	2.25
A story emphasizing the sea otter's struggle for existence.		
Birds		
Feathered Flights. By Charles H. Gable and E. S. Quillin. 47 pp. '44. Whitman	4	.50
A description of the habits of seven common birds. Kingfisher, scissor-tail, bluebird, turtledove, butcher bird, swallow, and verdin.		
The Tale of the Wild Goose. By H. B. Kane. 43 pp. '46. Knopf	4	1.75
This exceptionally well written and beautifully illustrated story will interest boys and girls of all ages.		
Birds of the World. By New York City Writers Project. 205 pp. '38. Whitman	5	1.75
Over 100 biographies with an equal number of excellent photographs. The pictures could be used at any grade level.		
Electricity and Magnetism		
The Talking Wire. By O. J. Stevenson. 207 pp. '47. Messner	6	2.50
The story of Alexander Graham Bell. Interestingly written and might be used by good readers at a lower level.		
Thomas Alva Edison. by G. H. Garbedian. 231 pp. '47. Messner	6	2.50
The biography of the man who invented the incandescent electric lamp.		
General Nature Study		
Anywhere in the World. By I. E. Webber. 64 pp. '47. Scott	2	1.50
The story of plant and animal adaptation. Begins with plants and animals of the temperate zone. The idea of adaptation is then applied to organisms of the arctic, the jungle, and the desert.		
Along the Creek. By Charles H. Gable and E. S. Quillin. 46 pp. '44. Whitman	4	.50
The formation, varieties and uses of clay; the habits of crawfish, the frog, and the mosquito; the meaning and composition of clouds, of steam, and of raindrops.		

General Science

	Gr.	Price
Finding Nature's Treasures. By Charles H. Gable and E. S. Quillin. 48 pp. '44. Whitman. Stories ranging from the location of the North Star to oil wells.	3	.50
How Big is Big. By Herman and Nina Schneider. 41 pp. '46. Scott From stars to atoms, a yardstick to the universe. Most of the book is devoted to illustrations based on the statements made.	3	1.50
Fun With Science. By Mae and Ira Freeman. 60 pp. '43. Random The nine sub-divisions are Things at Rest, Things in Motion, Liquids, Waters, Invisible Skin, Through the Air, Sound and Music, How Heat Acts, Electricity, Light and Sight. The suggested experiments are easy to perform and are good learning activities.	4	1.25
It Seems Like Magic. By J. V. Pease. 80 pp. '46. International... How a train runs, how an airplane flies, why a boat floats, what makes an automobile go, and other explanations that children enjoy.	4	2.50
Pioneering in Agriculture. By Ted Badley. 32 pp. '46. Merrill.... From George Washington to making sugar from sawdust and dresses from chicken feathers.	4	.20
Pioneering in Communication. R. S. Heppes. 32 pp. '46. Merrill.. A booklet that includes mail, newspapers, movies and radio.	4	.20
Pioneering in Science. By R. S. Heppes. 32 pp. '46. Merrill..... Electricity, cosmic rays, the fight against diseases, and finally the atomic bomb.	4	.20
Experiments in Science. By N. F. Beeler and F. M. Branley. 116 pp. '47. Crowell. Low cost experiments with the "why" as well as the "how" explained. Forty-three suggestions to follow.	5	2.00
Fun With Chemistry. By Mae and Ira Freeman. 58 pp. '44. Random. There are twenty-eight suggestions each with appropriate illustrations. The experiments were tested and really work.	5	1.25
The Gulf Stream. By Ruth Brindze and Helene Carter. 63 pp. '45. Vanguard. The story of how information about the gulf stream was obtained. Well illustrated.	5	2.50
How Much and How Many. By Jeanne Bendick. 188 pp. '47. Whittlesey. The facts about weights and measures including how they got that way and why.	5	2.00
Electronics For Young People. By Jeanne Bendick. 175 pp. '47. McGraw. An introduction to electronics. It also is an introduction to atomic theory and nuclear power.	6	2.00
Famous Men of Science. By S. K. Bolton. 308 pp. '46. Crowell... A re-print of a collection of biographies that first appeared in 1926.	6	2.50

Insects

Thin Wings. By Charles H. Gable and E. S. Quillin. 46 pp. '44. Whitman. A small book about dragon flies, wasps, ants, crickets, and dobson flies.	3	.50

Plants

From Seed to Tree. By Charles H. Gable and E. S. Quillin. 48 pp. '44. Whitman.	4	.50

	Gr.	Price
The growth of a tree is explained to four children. They also learn about flowers, the age of trees and how maple syrup is made.		
American Trees. By R. T. Limbach. 38 pp. '42. Random..... Descriptions of fifty-five different kinds of trees written by a horticulturist. The book is well illustrated in color.	5	1.00
Science and Industry		
Pioneering in Industry. By Ted Badley. 32 pp. '46. Merrill..... The story of the development of industry. Power machines, mass production, light metals, oil and marketing are part of the story.	4	.20
Transportation		
Pioneering in Aviation. By Ruth Wolfe. 32 pp. '46. Merrill..... The story of the development of aviation including a look into the possible future.	4	.20
Pioneering in Ways of Travel. By Ruth Wolfe. 32 pp. '46. Merrill Wagons, steamships, trains, and automobiles and a brief history of their development.	4	.20
Balloonist from Brazil. By L. A. Stevers. 83 pp. '47. Beckley..... The true story of Alberto Santos-Dumont including an account of his first airplane flight in Europe and his dirigible flight around the Eiffel Tower in Paris.	5	1.00
Amelia Earhart. By Shannon Garst. 191 pp. '47. Messner..... A biography which should be of special interest to air-minded girls.	6	2.50
Eight Hours to Solo. By H. B. Lent. 134 pp. '47. Macmillan..... What happened when Andy Stewart went to the airport and signed up for flight instruction? The text was checked for accuracy by Mr. Lent's flying instructor.	6	2.00
Fly It Away. By H. B. Lent. 108 pp. '46. Macmillan..... How one of America's most famous small airplanes is built. A step by step description of the assembly line.	6	2.00

PUBLISHERS AND THEIR ADDRESSES

Beckley: Beckley-Cardy Company, 1632 Indiana Ave., Chicago, Ill.
Crowell: Thomas Y. Crowell Co., 432 Fourth Ave., New York 16, N.Y.
Harcourt: Harcourt, Brace & Co., 383 Madison Ave., New York 17, N.Y.
International: International Textbook Co., Scranton 9, Pa.
Knopf: Alfred A. Knopf, Inc., 501 Madison Ave., New York 22, N.Y.
Lippincott: J. B. Lippincott Co., E. Washington Sq., Philadelphia, Pa.
McGraw: McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 18, N.Y.
Macmillan: The Macmillan Co., 60 Fifth Ave., New York 11, N.Y.
Merrill: Charles E. Merrill Co., Inc., New York 19, N.Y. (Orders not accepted for less than five books.)
Messner: Julian Messner, Inc., 8 West 40th St., New York 18, N.Y.
Morrow: William Morrow and Co., 425 Fourth Ave., New York 16, N.Y.
Random: Random House, Inc., 457 Madison Ave., New York 22, N.Y.
Scott: William R. Scott, Inc., 72 Fifth Ave., New York 11, N.Y.
Simon: Simon & Schuster, Inc., 1230 Sixth Ave., New York 20, N.Y.
Vanguard: The Vanguard Press, 424 Madison Ave., New York 17, N.Y.
Whitman: Albert Whitman & Co., 560 W. Lake St., Chicago, Ill.
Whittlesey: McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 18, N.Y.

They are never alone that are accompanied with noble thoughts—SIR PHILIP SYDNEY.

SOME ETHICAL IMPLICATIONS OF SCIENCE*

A. C. Ivy

Vice President and Head, the Department of Clinical Science, University of Illinois Professional Schools, Chicago

I choose to speak on this subject for three reasons. *First*, many people are pessimistic regarding civilization and its problems. The public is becoming increasingly aware of the impact of science on the whole social structure. The scientist is also concerned regarding the social effects of his discoveries and his freedom in research. Questions of an ethical nature have been raised and discussed by scientists. And, a philosophy is being discussed regarding the relation of science to society. *Second*, I am speaking to teachers of science and mathematics who may as educators teach the ethical implications of their subject matter to their students and fellow citizens. My *third* reason for choosing this subject is to keep the thinking on the subject active. If scientific men are not to become tools of international gangsters or unreason, they should contemplate on and teach the ethical imperative and values of their activities. The traditionally narrow and cloistered viewpoint held by most scientists in the past, namely, that science is not interested in values, cannot be maintained.

The Problem

The problem is that civilization has developed much more rapidly in its material than in its ethical aspect, a fact that borders on tragedy. The difference has become so great that many scientists and public speakers have, in recent years pointed out this glaring and tragic defect. As everyone knows, applied science may be and has been used for the mutual destruction of national or political groups. Since the close of the hostilities of World War II many scientists have warned that atomic weapons and germ attacks may kill and maim millions where thousands were killed and maimed in previous Wars. There can be no doubt about this. Another war can and may ruin our civilization and leave gangsters in control of the remnants; a condition from which we have just escaped. It seems evident that material progress, science, and patriotism are not enough to preserve civilization. They are barren and dangerous without the association of spiritual and moral values.

Have we not then been overlooking to a large extent the real need and purpose of education?

The Goal of Civilization

It would now seem to be apparent that the rational goal of civiliza-

* Presented to the Central Association of Science and Mathematics Teachers, November 29, 1947.

tion is not to be found in material achievements alone. The rational goal is to raise the ethical, moral, and economic standards of living of all peoples without lowering them where they are now high. Nevertheless ethical and material progress are related, because civilization consists basically of the sum total of all progress which advances the ethical perfecting of individuals and communities and renders the struggle for existence less strenuous and makes man more free. This struggle has two aspects, one being against man's natural enemies and the other being against his fellowmen. Science has contributed much toward decreasing the struggle against man's natural enemies and hence toward the achievement of one aspect of civilization, but has done relatively little toward decreasing man's struggle with his fellowmen. Instead, science has added to the potential catastrophic aspects of man's struggle against his fellowman, so that the goal of civilization is now threatened by science, its material benefactor, because of the ethical weakness of man.

The Cause of the Problem

The lack of adequate ethical progress has not arisen because science lacks ideals, virtues, and altruism. The goal of science is to know the truth about man and the world in which he lives. The ideals of truth, happiness, and human welfare are unequivocally the objectives of science and scientists. The virtues of science are honesty, sincerity, courage, carefulness, perseverence, faith, altruism and cooperation—virtues which are requisite for scientific achievement. And, as a group, scientists manifest the most striking example of altruism and cooperation in human society; their collectively accumulated knowledge is dedicated freely to all mankind.

The lack of adequate ethical progress has been due to two or a combination of two general reasons. (1) Either human nature is more difficult to understand and direct in ethical matters than it is to understand and control material nature (2) or, the subject of the understanding and direction of human nature has been woefully neglected by educators. By educators, I mean parents, school teachers, clergymen, scientists, and the operators of newspapers and magazines, cinema and radio. In fact, I believe that the lack of ethical and spiritual progress can be placed on the shoulders of the presumably liberally educated leaders of social, professional, and political groups in the world, who use their intellect, knowledge and experience for purposes of ulterior self interest. At least, the solution of the existing predicament of the world is actually to a large extent in their hands; i.e., politicians and statesmen and others who mold the attitudes of the masses. When I say this I am not excusing from responsibility the educators of these leaders and politicians.

It must be granted that human nature is difficult to control. That such control is possible with the right sort of education is demonstrated by the fact that many persons manifest high grade ethical integrity. This comes not from inheritance but from the education of the individual in the home, school, and church, and other social groups.

Several factors have contributed to a poor ethical education.

First, as Natural Science advanced and demonstrated its usefulness, material matters became to be considered more basic than ethical matters by many philosophers, leaders, and politicians of the world. Many educators have exhalted scientific truth and reality and have refuted all ideals based on "imagination" or "pure reason." Hence, a distinction has been made between scientific truth and ethical and religious convictions based on rational belief. The unessential parts of dogmas and creeds have been attacked and refuted leaving many without any ethical authority. The fallacy has been that dogmas and creeds only have been attacked and the basic principles of religion which is essentially the same among most of the peoples of the world have been forgotten or ignored.

Second, with the rise of natural science, in the latter part of the 19th century, rationalism declined along with its optimistic ethical convictions regarding the purpose of human life and the universe. Philosophy began to have little to say of a constructive nature regarding human behavior. Personal morality began to be viewed as outside the realm of reason. The associated decline in thinking led to a lowering of intellectual standards. Conversation became more limited to generalities and superficialities. Education became so specialized that either correlation between the branches of knowledge in a curriculum cannot be made by teachers and students or they have no interest in such correlation. That is, there is too great a tendency for educators to know only the technicalities of the subject they teach. In addition, few students take courses in ethics, religion and philosophy in college (only 4 per cent) and stories and verses with an ethical or moral lesson have to a large extent been deleted from the reading matter in the grade and high schools.

A *third* factor which has undoubtedly retarded ethical progress is the faith placed in the mechanics of organizations and institutions to effect good, rather than in the ethical principles on which the organizations may be based and operated. For example, the materialist doctrine of Karl Marx is essentially devoid of ethical ideals since it preaches belief in an inevitable progress of a series of historical events in which the social institutions of slavery, feudalism, the bourgeois system will automatically replace private production by state or communistic production. In such situations, as recently exempli-

fied in Nazi or Fascist behavior, the amoral belief that the end justifies the means too frequently gains control. In fact, such amorality is a part of such political and social philosophy. The individual, regardless of his ideals of personal ethics supports without thinking the impersonal ethics of his party or group. Here expediency more frequently controls behavior than morality. Individual ethics are sacrificed to the wishes of the majority. Thus, the institution demoralizes the individual. The cause of the failure of ethical progress to occur as rapidly as material progress is obviously complex and it has been partially considered here only to make such a point.

The Solution

Pessimism exists regarding the achievement of the ethical conception of civilization. Many persons who have pondered this question of the solution of the problem are completely pessimistic regarding the ultimate achievement of an ethical conception of civilization not only in the near future but in the distant future. They point out that ethical ideals will never be able to control the basic self-interest of human nature. I hasten to point out, however, that the implication of the second law of nature, the "survival of the species," is ignored by such an argument. And, it is the question of the survival of the species and its civilization which has ethical value and the destruction of which science has warned is impending unless the common interests of the species are held foremost in mind.

It has been pessimistically argued by philosophers that the perfection of the individual only leads to social anarchy and that the perfection of the group only leads to social regimentation, both of which would be intolerable. Both arguments are pedantic and assume too much. Huxley, discussing this matter from the viewpoint of evolution writes: "I have termed this gradual strengthening of the social bond,—the ethical process. I have endeavored to show that, when the ethical process has advanced so far as to secure every member of society in the possession of the means of existence, the struggle for existence, as between man and man, without that society is, *ipso facto*, at an end.... In other words, the kind of evolution which is brought about in the state of nature cannot take place." This dilemma does not necessarily apply to man. Man is not bound by the limitations of lower animals. It is in man's power to control and direct his dominant tendencies from the viewpoint of an ethical purpose. Ethical values or purposes have enabled many men to use leisure for wise and peaceful purposes which involve almost as much interest as that engendered by a bitter struggle for the existence of one's life.

The non-moral conception of civilization pessimistically regards all symptoms of degeneration as symptoms of senility, so that nothing

can be done about it. This view holds that *a* civilization and not civilization is dying. But today we are so closely knit that all mankind is in danger. Such unthinking optimism or indifference, or the resignation, the like of which attended the fall of the Roman Empire, as well as unthinking pessimism, which refuses to believe in ethical progress, will have to be overcome.

Nevertheless our material progress has been so great and our ethical progress so disproportionately small, it is not easy to have faith in the future of ethical progress, particularly at this time. But, we can gather support for courage from the fact that pessimism, indifference, and resignation are the antithesis of scientific endeavor, and from the fact that the scientists' work is based on the hope of achievement. We can believe that there is no sound reason for a scientist to believe that the ethical conception of civilization cannot be achieved in time.

However, positive action will be required because the history of the earth and of man records that it is not necessary to believe that either man or his present civilization will survive. The record shows that knowledge and its organized rational use is necessary for the survival of a civilization. The misuse of knowledge and reason has caused the fall of civilizations. Smart men or groups of smart men can prevent the use of knowledge to organize lawlessness, to cause mistrust, and to debase communities and national groups. So, the concept of inevitable progress is false unless a positive action is taken to cause honesty and decency and hope to prevail among all men who have the common goal of improving the common inheritance of all men in the course of time.

It has also been argued that the evolution of society in a favorable direction cannot be stopped, that the result of evolution has been the creation of man who has gained greater control over his physical environment than any other species and that this insures his survival and an evolution of civilization. But, today this argument boomerangs, because unless an ethical principle prevails, man may destroy himself or his civilization by the fact that he knows so much about his physical environment.

The Role of Scientists in the Solution of the Problem

It has been stated and more frequently implied that scientists are responsible for the uses made of scientific discoveries. The truth of such an idea is readily challenged. For example, the Creator of the forces and laws of Nature is not responsible for the way they are used by man. Certainly Columbus is not responsible for the way America is being used by man, or how some men treated the Indians. If the scientist were responsible for the uses made of his discovery, then he

would be subject to discipline and the loss of scientific freedom. The scientist cannot make his contribution unless he is free. Even undue committee control of scientific endeavor by so-called experts is dangerous. There are too many cases where the progress of science has depended on the fact that *a* scientist has not been discouraged by the disapproval of experts. No one has the wisdom to set limits on what is really an endless frontier. And, further, the application of a discovery is practically always made by industrialists not by scientists. It is the manufacturer and salesman of the product of the discovery that should be controlled, not the discoverer. ***Truly the only solution for the problem of the misuse of scientific discoveries is the development of a good society.***

The scientists, however, do have an educational responsibility to discharge toward the solution of the problem. Scientists in order to preserve their freedom and to help create a society which will properly use the discoveries of science will have to leave their laboratories occasionally and help educate the people. Science influences every aspect of human endeavor and its contributions to human welfare are so important that the scientist must see his discipline in its broad social context. If the ethical judgement of the people is to be enlightened, scientists must take part in the education of the public and the development of social policy. To teach is the responsibility of those who know. No one can convince the public better than a scientist that the discoveries of physics, chemistry, biology and medicine have resulted from freedom for scientific endeavor. No one can teach or warn the public about the misuse of scientific discoveries better than scientists. In view of the tremendous effect of science in augmenting happiness and alleviating suffering, the civic duty of the scientist is large. For example, research on atomic energy for peaceful purposes would have been greatly handicapped if the atomic scientists did not oppose the establishment of restrictions by Congress. If physiologists and physicians did not constantly oppose antivivisectionists, the chief means of medical progress relative to the cause and treatment of disease would be catastrophically curtailed within a period of four years, because within that period every state legislature would pass an antivivisection law. If such a law were passed, tens of thousands of persons would be condemned to suffer the consequences of disease the cause and treatment of which is now unknown. Unless scientists continue to warn the people of the world regarding the catastrophic consequences of an atomic and germ disease war, such a war is more likely to occur with a consequent appalling loss of life and misery and suffering for millions.

The most important aspect of realism today is to recognize that human welfare and any hope of achieving a rational civilization de-

pends less on inventions than on advances in morality, honesty, tolerance, and reason. A positive morality is the only insurance against another tragedy in human affairs.

The Positive Morality of Medical Science

Medical science since the time of Hippocrates has had a positive code of morality which has persisted and guided physicians for 22 centuries. Yes, it has had more influence at certain periods than at others and there are individual physicians who disregard its precepts. Nevertheless, it has been upheld and practiced by the majority of the profession at all ages. And, it is difficult to conceive of a society without an ethical basis for its medicine.

It is quite significant that scientific medicine and the ethics of medicine were originated by the same man and his disciples. Hippocrates, commonly called the Father of Medicine, provided one aspect of *the scientific philosophy of medicine* as we know it today. He overthrew the idea that disease was due to evil spirits and the wrath of the gods for the idea that disease is due to material causes. He established the beginning of the descriptive science of medicine. The experimental method was later developed by Galen. Hippocrates also introduced *a technical philosophy* when he emphasized the importance of the development of art and skill in medicine by diligence and exercise of the intellect. In addition, he provided medicine with *a moral philosophy*. He apparently realized that a scientific and technical philosophy of medicine could not survive without a moral philosophy. Every medical student and physician throughout the world has read the oath. In many medical schools, the graduates repeat the oath as a part of the graduating exercises. And, if a physician departs from the oath in his conduct, the ostracism is not easy to bear.

The first paragraph of the oath enjoins the physician to guard the standards of admission to medical schools, the standards of medical education and licensure, and to place any medical knowledge he discovers at the free disposal of all physicians.

The second paragraph states: "I will follow that method of treatment which, according to my ability and judgment I consider for the benefit of my patients, and abstain from whatever is deleterious and mischievous. I will give no deadly medicine to anyone if asked, nor suggest any such counsel; furthermore, I will not give a woman an instrument to produce abortion." *This paragraph very significantly commands a respect and reverence for life.* It forbids the random and unnecessary or the "trial and error" use of irrational remedies of disease. It is the basis of the therapeutic principle that the treatment should cause no harm. Without the enforcement of this paragraph

by the profession, the public would have reason to lose faith and confidence in the profession.

The third paragraph states: "With purity and with holiness I will pass my life and practice my art. Into whatever houses I enter I will go into them for the benefit of the sick and will abstain from every voluntary act of mischief and corruption; and further from the seduction of females or males, bond or free." This commands the manifestation of high grade moral character by physicians toward all people regardless of their social and economic status.

The third paragraph also states: "I will not cut a person who is suffering with a stone, but will leave this to be done by practitioners of this work." This enjoins the physician from doing that for which he is not fitted.

The fourth paragraph states: "Whatever, in connection with my professional practice, or not in connection with it, I may see or hear in the lives of men which *ought not* be spoken abroad, I will not divulge, as reckoning that all such should be kept secret." This injunction also is necessary to maintain the confidence of the patient and the public in the profession.

Obviously honorable conduct and secrecy are essential for correct diagnosis and treatment. Yet, it has been necessary for the profession to defeat many attacks on the necessity of honorable and completely confidential relations between the physician and patient. This obligation of the profession to protect the public from "deadly medicine" has been criticized by laymen with little appreciation of the consequences.

After all, the Hippocratic Oath is only the Golden Rule or the Christian ethic of "love your neighbor as yourself" expressed medically. It represents how one physician would like to be treated by another physician. It only teaches that the welfare of the patient is the prime moral interest of the good physician and that the prime object of the profession is to serve humanity by maintaining life and postponing death.

History records that when these basic principles have been forsaken an atrocious disregard of the value of life follows. The most recent example of this is represented by the atrocities committed by a small group of Nazi-SS physicians during World War II. These physicians, freed from all moral restraints by the Doctrine of the Master Race, forced human beings to serve as experimental subjects. They did the experiments not with the idea of benefiting humanity but with the idea of advancing their own political standing in the part or the ideology of National Socialism.

To National Socialism of Nazi Germany the welfare of the state and of the army was the Supreme Good. It had no regard for the

rights of the individual. There was no place for the ethics of medicine which teaches that the physician-patient relationship is a holy and individual matter. In fact, Himmler referred to those few who voiced some opposition to the experiments as having "Christian Medical ideals." Anyone who disagreed with Himmler's ideas regarding the use of human beings as experimental subjects was a traitor and was to be shot or hanged. The dishonesty, trickery, and brutality revealed by a review of 250 documents submitted in evidence against a score of Nazi physicians at the Nuremberg trials is appalling and would be incredible if these documents themselves did not reveal the lack of morality of the Nazi politicians and physicians.

National Socialism after 1933 affected medicine in other ways. In order to enter medical school it was necessary to be trained in the Hitler Youth Organization. After entering medical school, party and SS-affairs such as drills and meetings rendered it difficult for the students to attend classes. The student had to take a course in Nazi racial theory and pass an examination on Nazi ideology. After graduation, unless the graduate was a member of the party, it was very difficult to obtain an internship. The medical associations were taken over by the Nazi party members. Scientific sessions were practically discontinued because of the limitation of free and open discussion. If a non-party physician criticized a party physician, the former would soon find himself without a practice or in a concentration camp. The profession, silenced and with a gun at its head, was rendered impotent before it fully realized the seriousness of the situation.

In summary, German medicine during the Nazi reign of terror was political medicine at its worst.

Some 70 Nazi physicians were involved in the commission of the medical atrocities. When those who had not committed suicide and were apprehended were confronted with the evidence they adamantly at first argued that the end justified the means. But, when asked if they would like to be treated the way they treated their unfortunate victims, they said, "No." They could not withstand the penetrating and unequivocal morality of the Golden Rule. This simple and profound moral principle had been buried in the hysterical desire for power and the lying sophistry of the racial theory of the Master Race.

By teaching reverence for life whether it be the life of the poor or rich, the meek or the powerful, the welfare of the individual as well as that of the community will be advanced. If we could inculcate a reverence for life into the majority of human beings we could bring perpetual peace to mankind.

Medicine was the first to adopt in practice the conception of the rational world of the philosophers, in which the scientific process,

(Hippocratic method) on the one hand was combined with the ethical injunction (Hippocratic Oath) on the other. This conception should be adopted by all of science, since science can no longer proceed for its own intellectual interest.

Like medicine, science, and scientists as a group, have the advantage provided by the unusual acceptance of the methods and results of science among all peoples of the world. Men everywhere soon come to agreement on scientific facts and methods, regardless of race, religion, and politics. Scientists have a special opportunity to work together for and with other groups interested in advancing the welfare of man. Scientists should take, and some have been taking, the initiative in this matter.

International scientific societies now exist through the world, and they must and will continue to manifest their cooperative endeavor, and emphasize that no racial, religious, or political group can monopolize science, the contributions of which should be used for the welfare and not the destruction of man. Scientists cannot work alone but they can start a chain reaction of thinking and education among students and non-scientifically trained persons toward the achievement of an ethical and scientific conception of civilization.

NATIONAL COUNCIL OF MATHEMATICS TEACHERS MEETS AT INDIANAPOLIS

The National Council of Teachers of Mathematics will hold its twenty-sixth Annual Meeting at the Claypool Hotel in Indianapolis, Indiana, April 2 and 3, 1948.

Among the frontier thinkers in mathematics education who will appear in the program are A. J. Kempner, University of Colorado; C. V. Newsome, Editor—*American Mathematical Monthly;* Phillip S. Jones, University of Michigan; F. W. Kokomoor, University of Florida; Guy T. Buswell, University of Chicago; Raleigh Schorling, University of Michigan; W. W. Rankin, Duke University, F. Lynwood Wren, George Peabody College for Teachers; John R. Clark, Teachers College, Columbia University; Lois Knowles, University of Missouri; Philip Peak, Indiana University; Daniel W. Snader, University of Illinois, William Betz, Math Specialist, Rochester Public Schools; Joseph A. Nyberg, Hyde Park High School, Chicago; Henry W. Syer, Boston University; Irene Sauble, Public Schools Detroit; Mary Potter, Math Specialist, Racine, Wisconsin; Virgil Mallory, N.I.S.T.C., Montclair, N. J.; Rachel P. Kentston, Stockton H.S., Stockton, Calif.

More than fifty topics are listed on the program. The topics range from "Elementary Arithmetic in an Activity Program" to "Coordinating High School and College Mathematics. Although these topics concerning the philosophy of teaching mathematics have not been omitted the emphasis seems to be on methods and special techniques in mathematics teaching. There will be a continuous showing of the latest visual aids in teaching mathematics.

Reservations may be made by writing directly to the Claypool Hotel, Indianapolis, Indiana.

MAP CLINIC[1]

HARRY LATHROP

Normal University, Normal, Illinois

Maps and globes are two of the great inventions of mankind. They are part of the technical equipment of the engineer, the navigator, the surveyor, and the professional geographer, as well as lending helpful service to a score of other professions. However, it is through their universal service to all of mankind in various ways that they merit greatest consideration.

In addition to their technical service, maps are a vehicle of expression, a means of conveying knowledge, often in a more vital and economical manner than the printed page. They have been justly termed, shorthand records of knowledge. The amount of information contained on a good map is amazing and the varied relationships shown are truly unbelievable. The latter, however, are reserved largely for him who has learned to read the map. Map reading is not a difficult acquirement, but requires some knowledge of map projections and map construction and techniques.

The day is past when all levels of learning use the same map and globe. Formerly, map instruction to children and adults was much the same, varying chiefly in the quantity of factual information taught. We are just beginning to realize that maps and globes, graded for the various levels of learning are quite as important as graded readers or progressive arithmetics.

Today, at this Map Clinic, we are privileged to listen to a discussion on the minimum needs of maps and globes (and I hope something of their use) on five levels, from the elementary school through the college. Each speaker will present the subject for his particular level of learning. Dr. Espenshade is, not only a user and teacher of maps, but is a cartographer in his own right.

Following that presentation we are privileged to hear from the makers of maps. It is through the manufacturers of maps that the teacher must depend for good maps suited to the different levels of instruction. All of them are students of maps and their use and some of them are cartographers.

I am sure that from experts in the use and teaching of maps and globes, from the cartographers who devise the maps, and from the manufacturers who supply maps and globes to schools we shall learn much. I look forward to a two-hour feast of a good and wholesome diet from this Map Clinic.

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[1] Presented at the Geography Section of the Central Association of Sciences and Mathematics Teachers, November 28, 1947.

1. MINIMUM ESSENTIALS IN MAPS AND GLOBES IN THE PRIMARY GRADES

ISABEL K. BILLINGS
Hawthorne School, Oak Park, Illinois

Before either a map or a globe is presented to a primary child, he should become familiar with many pictures, showing people living and working in their natural and cultural environments. Pictures which show how people have adapted or used the natural landscape to fit their own needs, will give the child a background on which new geographic concepts can be built. By using pictures as a base on which to build, we can move from the known, actual landscape to the unknown area of map symbolism. The pictures need not be expensive, commercial prints. Many of the newspapers and magazines often contain very fine photographs that can be used effectively. For example, prints from old textbooks, *Life* magazine, *Fortune*, and the *National Geographic* can be selected, evaluated, and filed for use.

One concept, that of a round earth, needs careful introduction to children of the primary grades. To develop this concept, the first essential in equipment is a globe; preferably a 12 inch cradle type that can be held comfortably in the hands of a small child. In this way he gets the "feel" of a round earth, the concept of the earth's suspension in space with no pole or rod running through it. He can shift this type of globe to any position so that he can see any part of the earth clearly. For example, he can hold the globe so that he can look directly at the southern hemisphere. In fact he should form the habit of doing this, so that he doesn't get the notion that south is "down." The cradle globe, too, is most practical because it is free from awkward bases, pulleys, iron bars, and other disturbing paraphernalia.

The first globe should be a simple, physical globe, with not more than two colors, one representing the oceans, the other the continents. It should be the type on which the child can write or draw identifications of places, routes, directions, and boundary lines as these concepts are developed. In this manner he will not be confused by finding too many things already superimposed on an earth with which he is not familiar.

In the fourth grade, a slightly more complicated physical globe, to which a few of the most important political features have been added, can be used. Such features as cities, and the outlines of countries are valuable teaching aids at this level. Here, again, we do not want too many place names, boundary lines, or other symbols to clutter up the globe, making it unintelligible to the neophyte geographer, for such is this fourth grade child.

After the child has the concept of the round earth, an orange peel can be used to demonstrate the flattening process, in preparation for the use of the wall map. First and foremost, in grades three and four, let us have a good physical or physical-political map of the world. It should be one with as little distortion as possible, probably a homolographic or homolosine projection, where the greatest distortion comes in the polar regions. The interruptions should be in such a place as to cause the least confusion in the mind of the child; again, perhaps in the polar regions;—certainly not bisecting Asia as many of our maps do.

If possible, a map of each continent is very valuable, especially in fourth grade. These and the world map should be of the same size and on a scale that can be used for comparative purposes. The child can get a "feel" of scale if we have a 12 inch globe and wall maps whose scales are multiple units of that on the globe.

A fourth essential is a chart or diagrammatic picture showing actual natural landscape features, such as Manhattan island, New York harbor, San Francisco bay, the Rocky mountains, and the Gulf of Mexico. If it is not possible for these to be purchased, use pictures of them and follow up by making your own diagrams with your class.

The Qualities of a Good Map

Dr. Renner of Columbia University states in an article in the *Journal of Geography* for January 1941, that there are three criteria for a good map. They are: 1. visibility; 2. simplicity; 3. usefulness of content or data. In the same article he gives us some very useful measuring sticks with which to judge a good map. These are as follows:

1. The map should be large; no smaller than four feet by eight feet, so that it can be seen by the children in the back of the room. A map is not a decoration but is to be used for information.
2. There should be no insets or small maps in the margin. Such material keeps the map from being legible, reduces the size of the master map, and gives false concepts of space relationship. The wall map is not intended to be an atlas and should not be used as such.
3. The elements on the map should be large. Big dots or discs, the size of a quarter or half-dollar should be used to represent cities. Rivers should be represented by bold, blue ribbons. Shorelines must be determined black lines. Names of cities should be written in lower case type one-half to one inch in height.
4. The legend should be legible from the back of the room.
5. The color scheme should be unobtrusive; a harmonic, chromatic arrangement of color with an attempt at standardization. For ex-

ample, the use of the international color symbols for elevation could be used.

6. There must not be too much on the map.

7. Gradation of color should show physical features rather than elevation. Two areas may be the same height above sea level, yet one may be a high plain, the other a mountainous region. If both have the same coloration on the map, the child gets an erroneous idea of the natural landscape which is just what we are trying to avoid. On the other hand, if maps were colored so that plains, hills, plateaus, and mountains were clearly discernible, all children would have a better concept of the regional, physical landscape, as well as that of the earth as a whole.

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2. WHAT CONSTITUTES THE BASIC MAP AND GLOBE NEEDS FOR THE JUNIOR HIGH SCHOOL LEVEL?

MONICA H. KUSCH
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In this discussion of basic map and globe needs at the Junior High School level, the assumption is made that the student has by now completed a regional study of the world, continent by continent and has studied minor sub-divisions within each continental mass. Generally, then, at the Junior High School level, the geography of the world is approached from an economic point of view, studying the world distribution of population, of natural resources, and of the various occupations and industries in relation to the patterns of climate, surface features and soil, and likewise observing each individual cultural pattern in relation to the numerous other cultural, physical and social world patterns.

On the above assumption, map and globe needs for the Junior High School level are as follows:

GLOBES

Every Junior High School room in which geography is taught should be equipped with one 16 inch physical-political globe, preferably one that is free-mounted and can thus be easily taken out of the frame and held in the hand allowing for greater flexibility in globe use. The symbols used on this physical-political globe should be the same as those used on the flat wall map of the world, thus increasing the student's ability to note unavoidable cartographic errors on the flat world map. Globes, like wall maps, should not be cluttered with

unnecessary detail which can be found more accurately on a detailed atlas map.

Equally as essential, at the Junior High School level, is one of the various slated globes with continents shown in relief. Trade routes based on the great circle route can thus easily be shown as can the distribution of crop areas, minerals, and the various industries, emphasizing, in particular, the relationship between the chief producing areas and the chief consuming areas.

Maps

The basic essentials in wall maps are: one world map on an equal area projection, one wall map of each continent and a wall map of the United States. If only one world map is available it must be on an equal area projection, but if more than one world map can be purchased a world map showing true shape instead of equal area is desirable to counteract the distortion of shape often seen on an equal area map. The basic requirement, that a world map should portray the *entire* surface of the earth cannot be overemphasized. Too many world maps end at about 80 degrees north and 60 degrees south. Numerous misconceptions can be traced to the fact that students have used a world wall map with the equator not in the middle and with ocean and land areas south of 60 degrees south entirely missing.

Continental maps may be drawn on a large number of projections. Some projections produce better maps for low latitude regions and other projections or combinations give truer shape and area in middle or high latitudes. A regional map of a comparatively small area does not always have to be based on an equal area projection.

The *symbols* on the map should be clear-cut to carry across the average classroom. The symbols used on the maps should be consistent throughout the entire set of continental maps. For instance, if the smallest city shown on the map of Europe is a city of 500,000, then the map of Africa should show no city dots for towns that are smaller than that, despite the fact that there will be very few dots on the map of Africa. We must repeatedly emphasize the fact that the absence of cultural or natural phenomena in any given area is as significant as is the presence of these phenomena elsewhere.

The *color scheme* showing elevations should be the one in standard use and must be clear and strong to carry across the classroom.

Every map should have a *legend* showing scale, type of projection and symbol meanings.

Wall maps should not be atlases of detailed information. Such information clutters the map and places in the background its chief purpose, namely that of giving a general picture of an area as a whole. At the Junior High level good atlases are very essential to gain the

much needed detailed information concerning specific areas.

A slated wall map of the world and of the United States is highly desirable at the Junior High level of learning. These may be used to sketch in the patterns of distribution of the various industries or resources studied. Desk outline maps should be on the same projection so that the slated wall map may be a check and a directive for the work the student does on the outline map.

If special purpose wall maps have not been used at lower levels of learning, they should be secured for the work in commercial, economic or general geography at this level of learning. These special purpose maps include:

A population distribution map
A rail distribution map
A rainfall map
A temperature map
A map of climatic regions
Maps showing distribution of resources, industries and trade routes

All of these special purpose maps should show the entire world, rather than that part where the distribution pattern exists.

We can say a great deal about the types of maps and globes and other equipment we should have at the various levels of learning, but unless we use this equipment again and again, even the best materials will not send students out from our schools with a basic knowledge of maps or the ability to gain information from them. Perhaps I might summarize all I have said on map and globe needs in this sentence. "Secure the best equipment you can get and then *USE* it, for the manner in which you *USE* the equipment and the frequency with which you *USE* it are the basic factors which determine the degree to which a student can use maps in subsequent school work or in actual living experiences."

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3. MINIMUM MAP ESSENTIALS FOR THE HIGH SCHOOL GEOGRAPHY ROOM

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I have been asked to give some definite and practical conclusions concerning minimum map equipment which have grown out of my full experience in the high school classroom. Some of the statements which I shall make may seem oversimplified, but there are really only a few important cores to any problem, and they are essentially simple when ferreted out.

One should not be too discouraged at first by lack of materials. It is amazing how creditable a job can be done by a skillful and re-

sourceful teacher. One of my most inspiring college courses was given in a bare downtown office building room with only the map materials which could be carried in a brief case. In that case it was the genius of the instructor and the inherent interest of the students. However, we are not all geniuses and our students are not always eager, so we need the best help we can get.

It has been my experience that one is more frustrated when confronted by a large collection of non-usable maps. The money and storage waste is disheartening. Right now, to mention one, I have a beautiful new heavy oaken case of twelve maps representing an outlay of about $125.00 gathering dust in a corner, because for reasons which I shall point out later, it is almost totally useless.

Part of the reason why rooms are not better equipped is that many teachers have not taken time out to think the problem through and make a list in black and white to use as a consistent goal throughout the years. Too often the map man appears at an inopportune time and decisions are made on the fly, or at an impromptu ten minutes department meeting. I have made just such a list for myself to present to you this afternoon, a list of what I should select by way of minimum essential map equipment, if I had free choice.

For clarity, let us divide map materials into several groups. Wall maps, globes, atlases, outline maps and text book maps. Each has its distinctive utility. I shall discuss each briefly in turn.

Wall Maps

It is important that users of wall maps be well aware of their function and especially of their limitations. Wall maps have a strictly pointer use, that is, in addition to familiarizing one with the large contours, the major use is for the teacher to point to the feature which he wishes the pupils to examine more closely at hand. A wall map is not a substitute for an atlas. It is a mistake to crowd it with details which are not visible at a distance and which only obscure the larger important features.

I should like to reemphasize three wall map characteristics which I consider especially vital. First, I should like all my wall maps to be physical-political. Since topography is so important in helping to explain man's adaptation, a purely political map is of curtailed use in the geography room. It would seem that in 1947, such a statement is superfluous, but in reality it is not. Second, and I stress this point earnestly, I should want them to have latitude clearly marked with numbers close enough to be functional. The very facts of economic life itself are closely tied up with latitude. I have worked for a number of years with a beautiful world map upon which 0, $23\frac{1}{2}$, $48\frac{1}{2}$ and $66\frac{1}{2}$

are the only numbers which appear on the borders. Did you ever try to stand close to a large wall map and quickly announce the latitude of a place which you estimate is about ¾ of the distance between 23½ and 48½? Third, I want to see strong city dots, overemphasized, if necessary. City dots give indication of population pattern. Clusters of dots point to industrial activities. In my unit "Overview of Western Europe," I ask the pupils to list the cities in Western Europe and in the United States, both being areas similar in size. Five in the United States as contrasted to sixteen in Europe, quickly gives one a clue as to the population pressure in Europe with its attending implications.

Regional Wall Maps

It is not so difficult to obtain world and continental maps which conform to these qualifications. I have seen some. I have several. It is in the fields of wall size regional maps where the want is most felt. I make a plea that we have more maps of major countries and regions and that they too show highlands and that the city dots be bold and strong.

The only wall size map which I was able to get of Britain is one entitled "British Isles—Industry and Population." Patches of bright pink show dense population, green moderate and yellow sparse. The only other symbol which stands out conspicuously is the dark blue spots which denote iron ore. Local iron ore is relatively unimportant in the British Iron and Steel industry. Coal deposits of vital importance, on the other hand, are shown in hardly noticeable fine black dots on this map. The small red lettering, wheat, fruit, farming, mackerel, herring, deer, timber, etc. neither adds or detracts, as it is too small to be seen clearly. My oaken case contains twelve of these "Commercial Development" maps, all of the size of the map of Britain, but with infinitely more detail. The one of Eurasia is just one indistinguishable mass of tan, green, red, and black lines, dots and letters. A large physical political map of Britain would be far more useful in helping students realize for example, that:

One reason why Britain depends upon the outside world for most of her food supply is that almost three-fifths of the land is too rugged for crops; that sheep are the number one livestock in Britain, whereas cattle take first place in the Irish Free State; that the rainfall decrease from east to west is accentuated by the mountains; that cities, so probably industries, are confined to the south coast of Wales; that the population of Scotland is concentrated in the lowlands between Glasgow and Edinburgh; and that in traveling from Southampton to London one passes the North Downs part of the exposed eastern sea end of which forms the famous "White Cliffs of Dover."

Text Book Maps

I suppose teachers realize that the most frequently used maps are those found in texts where they can be examined closely.

Working with small maps like the three found in the[1] Colby-Foster *Economic Geography* chapter on Britain, together with a wall map used for pointing, the coincidence of coal fields, manufacturing districts, population concentrations, railway nets and lowlands can be strikingly illustrated.

Atlases and Globes

One or two atlases, of course, for reference is a *must* for every room. A set, one for each pupil is not too much to hope for. The same is true of globes. A large globe is indispensable. A set of small ones for individual inspection is highly desirable.

Outline Maps

I know of no better way of summarizing and fixing geographic findings than by recording them on an outline map. The notebook size is convenient. The wall size makes a striking display.

An Ideal Room

And now, what should I choose for my ideal high school Commercial Geography Room? I should choose: One, a good set of world and continental maps, which conform to the simple standards just outlined. I should want as many as possible, but at least, the World and United States mounted separately, so as to be always on display. I should want them solidly mounted with rollers that work and strong pull cords so as to be able to reach them. Too long I've operated under the "Jump—Tug and Dodge System."

Two—I should like one or two cases of commonly used regional maps like Britain, France, Germany, Japan, Mexico, Central America and especially the Soviet Union, so urgently needed.

Three—Paper outline maps of desk and practicable wall size with a special cork board for quick mounting.

And then, four, a set of atlases, one for each pupil, and last, a large globe, preferably pivot mounted accompanied by a set of small globes. All this plus several sets of textbooks and workbooks rich in special purpose maps and I should be satisfied. Some may think this too much to aspire to, some may think it is not enough.

Today in most cases it is not so much a shortage of funds as it is selecting the most effective materials for the allotted sums. Only last

[1] Figure 241—Landform, principal cities and principal railways of Britain P. 433; Figure 248—Principal cities, coal fields and iron working of Britain P. 445; Figure 250—Principal manufacturing districts of Britain P. 447.

week I was called in to help sort and discard wall maps. I saw how the cost of sets of Atlases and globes could easily be met by savings accrued from more careful buying. If we are clear about what we want and it is within reason, and we are both persistent and patient, I feel sure that both the map makers and the administrators will cooperate.

THE PSALM OF MATHEMATICS

L. R. POSEY, *Head of Math. Dept., Southern University, Baton Rouge, Louisiana*

Tell me not in terms of numbers
Math is but an empty dream;
For the soul is dumb that slumbers,
Problems are not what they seem.

Math is real! Math is sound!
Flunking you is not its goal.
Abstract thinking is renown,
For the alert ambitious soul.

Not enjoyment, and not hate,
Is its destined end or way;
But to act before too late,
Gaining knowledge day by day.

Skill is slow, and time is fleeting.
Study, practice and be brave,
Don't try stealing neither cheating
Such will make you but a slave.

In the world's broad field of math
In the youthful span of life
Be not like dry worthless chaff
Be a worker in the strife.

Trust no guessing howe'er pleasant!
Let sound thinking be thy guide!
Act—act in the living present!
Heart within, have a scholar's pride!

Great mathematicians all remind us
We can make some mark of kind
And, departing leave behind us
Blueprints of creative mind.

Blueprints, that perhaps another
Failing math's primary aim.
A forlorn and doubtful brother
Seeing, shall take heart again.

Let us then be up and going
Keeping heart both soon and late
Still achieving still pursuing
Learning math at normal rate.

WHAT MAKES THE WEATHER CHANGE?

FIFTH GRADE SCIENCE UNIT

EDNA E. BYRNE
Miles Standish School, Cleveland, Ohio

HOW THE UNIT BEGAN

Many dramatic happenings in weather afford excellent opportunities for beginning this unit. Such an occasion in early spring offered itself to a fifth grade class at Miles Standish School, in Cleveland. Our science room faces east, and on this particular March day the sun was shining brightly, so all the shades were drawn. In about a half hour the shades had to be raised and the lights turned on. The sky continued to darken until, even with all the lights, the room was too dark for reading. We stopped our work and watched the sky. A very heavy snow storm raged for about a quarter hour. Then the sky cleared, and soon the sun was shining again.

The children were all agog. They asked question after question. As I jotted down their questions on the board, I realized that this was the right time to introduce the problem, "Why Does the Weather Change?" These were the questions that they asked:

What makes the clouds move so fast sometimes?
What is weather? Is it the same as climate?
Why do the seasons change?
What is a cloudburst?
Why does the air get cold at night?
Why does a hurricane strike in some places and not in others?
How is dew formed?
What causes lightning? thunder?
Can we always depend upon the weather man's predictions?
What makes the rain fall?
How can the Weather Bureau tell what is going to happen the next day?
How cold does it have to be before rain changes to snow?
If we get nearer the sun when we go up in a plane, why is it colder?
Why doesn't it rain all the time?
What is sleet? fog?
Do all clouds give rain?

Our unit was organized so as to include the children's questions. Many of the questions asked were answered simply by reviewing facts learned in other grades, or by performing again experiments they had done when they were studying about air in the fourth grade. For example, the children had learned that wind is moving air and that wind is both a friend and an enemy. They had also learned how to use a thermometer. Extensive study of the thermometer is a part of the third grade science program.

Activities to Aid in Learning about Weather

A science unit becomes more interesting, more meaningful to children, if activities are used. The study of weather offers opportunities for activities, perhaps more than almost any other unit. The boys and girls suggested many things they would like to do to help answer their questions, such as:

Could we visit the Weather Bureau?
Let's have our own weather bureau.
May we bring in the weather reports from the paper?
My dad reads the weather forecasts. Shall I bring them in?
I deliver the morning paper, so I can bring the complete weather report every day. We can cut it up, too.

Committees composed of those greatly interested in a particular activity went to work. Miles Standish School is on one floor; our classroom faces east. One door opens on a court where we set up many exhibits, use reference books, or work on activities that require more space than we have in our homeroom. The east door opens to the outside. This provided an excellent spot to make weather observations, and it made it very easy for the teacher to work with the committees. A committee of weather observers checked the sky—was it clear or cloudy? Another group put out the thermometer and read the outside temperature. We made a large thermometer and moved the mercury column, represented by red tape, up or down according to the report of that committee. This helped greatly in learning to read a thermometer accurately.

The group that reported on the direction of the wind had a "Doubting Thomas": he couldn't be sure the weather vane was correct until he had checked by holding out a handkerchief. Another had to wet his finger and hold it up for checking wind direction, "like the Boy Scouts," he said. When they were ready they returned to the classroom and reported. The official recorder wrote the record on a room chart under these headings:

Date
Temperature
Sky
Wind Direction
Rain or Snow

We used the weather report from the daily paper for the temperatures, the map, and the forecast. A committee read the temperature at 9 a.m., at noon, and at 3 p.m. The children registered these on individual graphs as well as on large graphs on the wall.

Next, a child read the weather forecast, and the class recorded the forecast in their notebooks. The next day we checked for accuracy against the actual weather. We did this to answer one child's ques-

tion: "Is the weather man always right?" Their findings, after three weeks' checking, convinced them that the weather man was correct about four-fifths of the time. They decided people should continue to listen to the weather forecasts because, as one child said, "Anyone could make some mistakes, and especially the weather man, as he has so many things to check."

A group of children made weather flags and according to the weather forecast hoisted them on flagstaffs on our science shelf. The frame was made by a group that had studied simple machines. They found a practical use for the pulley. The girls who made the flags kept the hurricane flag up on one staff. Perhaps the many hurricane headlines of this fall were responsible for this.

They made an anemometer consisting of three aluminum funnels mounted on arms, closing the tube in each with a cork. These in turn were mounted on an upright dowel rod. It moved with the wind as the small funnels caught the air and spun around. We had no meter for an accurate speed record, but because they had painted one funnel white and two black, they got an idea of wind speed by counting the number of revolutions per minute. A wind chart found in many science books provided a good guide for judging wind speed, for example:

Leaves move slightly	Practically no wind
Smoke does not go straight up	Light, 1–7 m.p.h.
Branches move; dust and papers blow	Moderate, 13–18 m.p.h.
Small trees sway	Fresh, 19–24 m.p.h.
Umbrellas hard to hold	Strong, 25–38 m.p.h.
Branches broken off trees	Gale, 39–75 m.p.h.

On rainy days we put out our rain gauge. A member of the class had made it at home. It consisted of a tin can and a funnel. The ruler on the outside was divided into quarter inches. The committee member in charge of this instrument was very diligent in his observations. Each time the sky was even partly cloudy, he rushed over to set out the rain gauge.

We also had weather vanes, one made in handcraft class, the other presented by an interested daddy whose daughter studied weather with our class.

Another instrument used was a barometer. Before making a barometer, we did a great many experiments to be sure the children understood that air has pressure. We often make mercury barometers, but this needs very careful supervision, so sometimes the children make and use a pop bottle barometer, consisting of a pop bottle and a pint jar. The directions are easy to follow: Fill a pint jar one-third full of water. Put a small amount of water into the pop bottle. Invert the pop bottle in the pint jar. If enough water is put into the pop

bottle, the level of the water in each container will be about the same. The pressure of air on the water in the pint jar will cause the water in the jar to rise in the neck of the pop bottle. The children learn by actual observation that when the water rises in the pop bottle (a rising barometer) it means fair weather, and that a falling barometer means unsettled weather. Sometimes we used a ship's glass. The children liked to check both the pop bottle barometer and the ship's glass before dismissal at the end of the school day.

We did not make a great study of clouds, other than to note clear, cloudy, and partly cloudy skies and to note that white, fluffy clouds (the cumulus) are present in the summertime; also to note that thunderheads precede electrical storms and that dark, heavy clouds precede rain or snow.

One activity gave an excellent pictorial study of weather and its phenomena. This was a scrap book, made this fall. It took us through several hurricanes, heavy rains, abnormally high temperatures, and even to the news headlines that so romantically remarked, "Autumn's Kiss Makes Summer's Parting Sweet Sorrow."

Children like to experiment, and the study of weather presents a wealth of opportunities to learn scientific facts by this method. By boiling water, the class learned the nature of a cloud. By running their fingers through the cloud of partly condensed water vapor, the children realized how easily a plane or a person could travel through a cloud. When they put a cold knife through the steam, they saw the drops of water and learned how water vapor is condensed.

How is dew formed? How is frost formed? One of these questions we answered by filling a metal cup with ice. The drops of water that gathered on the outside of the cup gave the children a better understanding of how stones, cold earth, and other cold objects caused the air that touched them to be chilled and the water vapor in the air to be condensed to form dew. To produce frost they followed these directions, from *Everybody Talks about the Weather*, by John Urban.[1] Fill a metal container with crushed ice; add salt. Next add water to fill the can. The outside of the can will soon be covered with frost. Adding salt brings the temperature of the mixture below the freezing point of water. When the water from the air condenses on the very cold can, frost is formed instead of dew.

To answer the question, "Why does the temperature change?" we performed this experiment. We took two jars of the same kind, one of which we painted black. Then we filled both jars with water, took the temperature of the water in each jar, and found it to be 72°F. We placed both jars in the sun for a half hour and took the tempera-

[1] Urban, John. *Everybody Talks about the Weather*. Elementary School Notes #1. 1947–48. Ginn and Company.

ture of the water again. The water in the black bottle was 76°, while that in the other bottle remained 72°. From this experiment they learned that when the sun's rays pass through a transparent material, like air or clear glass, they heat the material only a little. When the sun's rays strike a material they cannot pass through, they heat it more. That helped to explain that the air will be warmer in one place than in another. The children concluded that it is warmest over places where the earth is heated most.

The children performed another experiment that greatly interested them. Its purpose was to find out how air moves. We took a large wooden box, open in front, and in the top of it we cut two holes large enough for a lamp chimney. Under one of the openings we placed a small candle. A piece of glass across the front allowed the children to watch what was going on inside the box. We lighted the candle, then thrust a piece of smoking punk down the chimney that had no candle under it. The smoke moved *down* the chimney, across the box to the candle, and *up* the chimney over the lighted candle. Through the glass the children could watch the movement of the smoke as it was carried by the air. They learned that cool air is heavy and falls, while air that is heated becomes lighter and rises. This helped them to understand the cause of wind.

This fall, after our records had been kept for a time, children began to see the relationship between temperature and wind direction, that the north wind usually brings a drop in temperature, while the south wind is usually a warm wind. I called attention to the fact that our winds came mostly from the west, northwest, or southwest, because we are in the belt of the westerlies. A study of the temperature charts showed us the temperatures were unusually high, above normal, during September and October.

We checked back on our questions to see if all had been answered. If any remained unanswered, we read for information on the subject.

Toward the close of the unit the children made small dioramas showing fun and work in different kinds of weather. One was a coasting scene, with temperature about 32°F. Another showed swimming when the temperature was about 85°F. A group set up a large diorama representing winter fun. Powdered mica on cotton gave the scene a realistic appearance.

We took a little time for examining weather superstitions, to show how many common ones were untrue, such as:

If the ground hog sees his shadow on February 2, there will be six weeks more of winter.

If the coats of animals are thick, the weather will be severely cold.

If the birds' feathers are thick, the winter will be cold. The children decided that since no animal has any way of knowing what the winter will be like, they are not reliable weather prophets.

If March comes in like a lion, it will go out like a lamb. March is a changeable month. It may be lionish or lambish at any time during the month, either at the beginning or the end.

Rain before seven, shine before eleven. They thought that this could be a true saying, because most rains last only a few hours, and, too, because the cool morning air may cause condensation, while later toward noon the air will be warmer and can hold more moisture, so that the rain will probably stop.

Correlations

The arithmetic teacher helped the children in the making and reading of temperature graphs. Our large graphs were made in the mathematics class, the small ones, in science class.

In geography, the group studying the southern states was also the one studying weather. The many storms centered around the Gulf this fall gave motivation for place geography, and for a discussion of the difference between weather and climate.

Pictures showing influence of weather on our lives were done in the art class.

In language work, children impersonated different groups, such as housewife, aviator, school guard, and others, and expressed their ideas of how the weather affected them. The problem of vocabulary was an easy one, as words we needed to learn were in constant use in the headlines and were also to be found in the daily weather record of the newspaper. We sometimes had roll call using these words in short facts about weather.

We wrote a letter to the U. S. Weather Bureau at Washington and ordered several pamphlets.

Evaluation

To get the children's reactions to the unit, I asked this question: "Did you like weather well enough to advise your friends to study it? Why? Why not? These are some of the responses:

Yes, because now I know what all those words mean that are used in the weather report.

Yes, I learned to look for the weather report in the newspaper, I never knew there was such a thing. Now I am going to try to study the weather maps that are in the paper each day. I didn't understand them before.

I know from our check-up that the weather man is right about four-fifths of the time. My brother and I now listen every day to the forecasts over the radio. Today rain was predicted, so I brought my rubbers and umbrella, and am I glad! It sure rained hard.

I told my boy friend how I made the pop bottle barometer. We each have one at home that we both watch and compare notes.

I know now what that letter "F" on the thermometer means. It stands for Fahrenheit.

If other children study weather, they'll know winds from different directions bring different kinds of weather.

Our study of weather is not intended to make the children pro-

spective weather men, but, rather, to open new avenues of interest. It offers many opportunities for observing, for experimenting, and for gathering and recording data, and it offers a splendid opportunity for organization of children into groups, each group with a common interest. Weather is a subject available in any environment.

HELPFUL READINGS FOR PUPILS

Basic Text—Discovering Our World, Book II	Beauchamp, Melrose	Scott, Foresman Co.
An Introduction to the Study of Weather and Climate	H. B. Ward, W. E. Powers	Northwestern Univ.
Clouds, Air, and Wind	Eric Sloane	Devin-Adair
Everybody's Book of the Weather	Williams	Macmillan Co.
Everybody's Weather	Gaer	J. B. Lippincott
Exploring in Science Air is Real —Grade Four	Craig, Hurley	Ginn and Company
Fair and Warmer	Gaer	Harcourt, Brace
How and Why of Weather Knowledge	U. S. Weather Bureau	
How and Why Discoveries	Frasier	L. W. Singer Co.
Knowing the Weather	Longstreth	Macmillan Co.
Rain or Shine	Baer	Farrar, Rinehart
School Nature League Bulletin	National Audubon Society—Series 16, No. 3	
Science Education Series		
Clouds, Rain, and Snow	Bertha M. Parker	Row, Peterson and Company
Heat and Cold		
Our Ocean of Air		
The Air About Us		
Thermometers		
Water Appears and Disappears	Glenn O. Blough	
Science Every Day Grade Three	Craig, Hill, Baldwin	Ginn and Company
True Comics		
Weather	Gayle Pickwell	H. F. Newman
Working with Science Grade Five (Heat Changes Things)	Craig, Hill	Ginn and Company

HEAT—NEW UNIT OF AIR AGE PHYSICS SLIDEFILMS

The Jam Handy Organization, 2821 E. Grand Boulevard, Detroit 11, Michigan announces the completion and distribution of 11 discussional slidefilms under the unit title, *Heat*—the newest addition to The Jam Handy Organization's "Air Age Physics" teaching slidefilm series.

Subjects included in the new group are: 1—Temperature. 2—Heat Expansion. 3—Gas Expansion. 4—Measurement of Heat. 5—Fusion. 6—Vaporization. 7—Refrigeration. 8—Humidity. 9—Heat Transfer. 10—Putting Heat to Work. 11—Internal Combustion Engines. The material has been arranged to tie in with reading materials, textbooks, laboratory work and other special assignments. The information in each film is organized into several lessons with questions, explanations of principles and summaries of the material presented. Each lesson concludes with a series of questions to serve as guides for group discussion.

SCIENCE LEGISLATION
NATIONAL SCIENCE FOUNDATION BILLS

(Continued from February)

II. Digest of Material Regarding Science Foundation Legislation 1944–1947

(Compiled by Eleanor Johnson)

Establishment of National Science Foundation. Lynne M. Lamm. *Chemical and Engineering News, vol. 23, Aug. 120, 1945, p. 1316.*

Background of new Kilgore bill. Establishment of National Science Foundation proposed by Senators Kilgore, Johnson and Pepper as central scientific agency under Federal Government. Bush Report to President urges concerted program for assisting scientific research outside of Government.

"Science—The Endless Frontier." *Chemical and Engineering News, vol. 23, Aug. 25, 1945, p. 1420–1430.*

Summary of the report to President by Vannevar Bush.

"Summary of the report to the President on a program for postwar scientific research." Vannevar Bush. *Science, vol. 102, July 27, 1945, p. 79.*

Proposals in Congress for Promotion of Scientific Research. *Chemical and Engineering News, vol. 23, Sept. 10, 1945, p. 1532–1534.*

Gives essential points of S. 1285 (Magnuson bill) S. 1297 (Kilgore bill) S. 825 (Byrd bill) and S. 1248 (Fulbright bill).

Joint hearings in Congress on science bills. *Science, vol. 102, Oct. 5, 1945, p. 346.*

Hearings to begin Oct. 5 jointly on the 3 bills (1) Kilgore, Johnson, Pepper (2) Magnuson (3) Fulbright. Nations leading scientists to testify. Kilgore and Magnuson issue a statement that they are in full agreement with the President's desires. The President's demands are listed.

Joint hearings on science bills. *Chemical and Engineering News, vol. 23, Oct. 10, 1945, p. 1737.*

Hearings designed to summarize expert public opinion. Lists persons invited to testify in the first week.

Scientific research bills before the United States Senate. *Science, vol. 102, Oct. 25, 1945, p. 411–416.*

The three bills are in essential agreement as to basic aims. Both Magnuson and Kilgore bills provide for establishment of a foundation to support research in fundamental and applied science, and differ only in the detail of procedures and organization. Agency proposed by Fulbright bill is essentially complimentary to the Foundation. (Fulbright bill sets up within the Commerce Department a Bureau of Scientific Research to promote and develop new industrial processes and products.) Disagree in relationship to present structure of Federal government. Kilgore bill provides for support of research in non-governmental institutions (universities). Also empowered to make similar contracts with Government research. It is intended to coordinate and integrate all Government supported research. Magnuson bill provides for an independent agency supported by the Government but without functional relationship to any other governmental agency. Kilgore bill vests power in a Director appointed by President, with an advisory staff. Magnuson bill provides for a board of public members who serve without compensation, appointed by the President and responsible to him. Board to select Director. Kilgore bill specifies that all inventions and discoveries will become U. S. property, whereas, the Magnuson bill provides that all inventions, and discoveries will remain the property of the individual, and the inventor may dispose of patent rights as he wishes.

Industrial research pattern of the United States. Harold Vagtborg. *Chemical and Engineering News, vol. 23, Nov. 10, 1945, p. 1943–1945.*

Editorial predictions of future place of research in U. S.

Hearings on scientific legislation. *Chemical and Engineering News, vol. 23, Nov. 10, 1945, p. 1987–1998.*

The working draft, combining features of both the Magnuson bill and the Kilgore bill, which was used as a work sheet for easier discussion and more compromises in the Hearings is given in its entirety. Presents some excerpts from the vast amount of testimony, including statements by Bradley Dewey, Roger Adams, Vannevar Bush, Bernard Baruch, Irving Langmuir, Robert Patterson, C. F. Kettering, and Harlow Shapley.

The Magnuson bill. *Science, vol. 102, Nov. 23, 1945, p. 524.*

The Executive Committee of the Pacific Division of the American Association for the Advancement of Science gave unanimous support to the Magnuson bill, because it offers a broader program, grants scholarships and fellowships, has less possibilities for political interference, and because its Division of Publications and Scientific Collaboration will make scientific information available to the public.

Proposals for a National Research Foundation. *Science, vol. 102, Nov. 23, 1945, p. 539–541.*

At a joint meeting of the National Advisory Health Council and the National Advisory Cancer Council of Public Health Service, a survey of pending Science Foundation legislation was made giving its possible effects on the Public Health Service. They felt that the legislation was not clear as to the relationship of the proposed new body to the budgetary and research policies of existing governmental agencies. Recommended new legislation in which the autonomy would be maintained by existing research agencies.

Federal support of scientific research. *Science, vol. 102, Nov. 23, 1945. p. 524–525.*

Board of permanent officers of the Sheffield Scientific School of Yale University unanimously approved of the principle of federal support of scientific research, outlining four general principles: (1) complete freedom of research (2) administration completely free of political control (3) provision for support of fundamental and theoretical investigations (4) science scholarships to increase scientific personnel.

Pending legislation for federal aid to science. *Science, vol. 102, Nov. 30, 1945, p. 545–548.*

President Isaiah Bowman of Johns Hopkins called a number of outstanding scientists together on November 4 (Committee in support of the Bush Report) and prepared a letter to President Truman. They recommended the Magnuson bill because it best outlines the program suggested by Dr. Bush. They felt that administration should be in the hands of competent scientists and laymen without political control, and that it was not wise to subordinate control to a single individual who is answerable only to the President. The Board should choose its own chief administrative officer. This agency should be cognizant of Army and Navy research, but not necessary to control it. Should not include social sciences, and the legislation should not attempt to solve the government's patent policy. Text of letter given, as well as signatories.

Organization and support of science in the United States, by Dr. L. C. Dunn. *Science, vol. 102, Nov. 30, 1945, p. 548–554.*

An address to the University of Rochester Sigma Xi chapter. Develops theme that existing means of supporting science research are running out, and changes in the sources and form of support must occur. Chief concern is to keep science as free as possible. Will probably have to set up government agency, but it should not displace existing research agencies, but rather act as a coordinator.

The promotion of science by the government. *Science, vol. 102, Dec. 7, 1945, p. 581.*

Western Reserve chapter of Sigma Xi endorses principles of National Research

Foundation, but with following provisions: (1) Board of 9 appointed by the President. Board to choose director. (2) Researches supported through contracts, grants, and other forms of assistance. (3) Foundation given right to negotiate patent rights as particular situations may require in public interest. All these provisions are contained in Magnuson bill, so they therefore endorse the Magnuson bill. Must be assured that appointments will be non-political, and researchers free to choose, nature, scope, and method of research.

Support needed for Magnuson Bill. *Chemical and Engineering News, vol. 23, Dec. 10, 1945, p. 2181.*

Although the Magnuson bill was predominately favored by the witnesses at the Hearings, there seems to be a tendency on the part of some government officials to disregard the opinions of the experts whose advice they sought. Urges action in support of the Magnuson bill.

Committee organized to support Magnuson bill. *Chemical and Engineering News, vol. 23, Dec. 10, 1945, p. 2218.*

Statement issued by the Committee Supporting the Bush Report and the letter outlining the reasons for the Committee's action sent to President Truman.

Resolutions of the Southwestern Section of the Society for Experimental Biology and Medicine. *Science, vol. 102, Dec. 14, 1945, p. 607–608.*

Must have clear assurance of freedom of scientific endeavor. Expresses concern lest any interference with the necessary freedom of scientific work may result in a scientific orthodoxy.

Science and the government. H. M. Kilgore. *Science, vol. 102, Dec. 21, 1945, p. 630–638.*

Shows general agreement of need of a Federal Agency for National Science Foundation, but a lack of agreement in three matters (1) best form of top-management (2) best way to assure full publication and free dedication to the public of the results of federally financed research. (3) The best way to deal with the human—the social and economic problems which scientists can help solve. He, personally, prefers a single administrator with an advisory board of from 5–15, all appointed by the President. Desires to standardize the handling of all patentable discoveries. Would extend research to economic fields, if such was found to be necessary. Good presentation of Sen. Kilgore's aims.

Science legislation. *Science, vol. 102, Dec. 21, 1945, p. 649.*

R. Chambers and J. S. Nicholas, on behalf of the Union of American Biological Societies and the American Biological Society, endorsed the Magnuson bill, but felt the need for a National Science Foundation so urgent, they would recommend a joint bill which would embody the best and most workable features of both, rather than insist on passage of Magnuson bill.

Research, Industry and Government. Bruce K. Brown. *Chemical and Engineering News, vol. 23, Dec. 25, 1945, p. 2328–2330.*

A new attitude developing in certain sections of the American Public, and in Congress concerning the natural sciences. The National Science Foundation which is being generated in the government can affect industry either favorably or unfavorably depending on how it is handled. Patent question reviewed in light of industrial interests.

Federal Scientific research. R. G. Roberts and H. H. Beard. *Science, vol. 102, Dec. 28, 1945, p. 660–680.*

Mr. Roberts and Mr. Beard of the Chicago Medical School suggest that the National Academy of Science should have control over the distribution of 50 percent of the funds, while the other 50 percent should be distributed equally among the 48 states. They feel that widespread distribution of funds is essential and should not be given to a select few, particularly those few who have in the past been recipients of large grants from Rockefeller and others, and who will in all probability continue to receive such grants.

Science legislation and the holiday recess. Howard A. Meyerhoff. *Science, vol. 103, Jan. 4, 1946, p. 10–11.*

Gives reply of President Truman to Isaiah Bowman and his Committee in support of the Bush Report. Reiterates President Truman's demands of his Sept. 6, 1945 speech.

S. 1720 was introduced into Congress on Dec. 21, 1945, by Kilgore, Johnson, Pepper, Fulbright, and Saltonstall. Will supersede S. 1292 (Kilgore bill) but Senator Magnuson is not committed. S. 1720 is a serious endeavor to meet the demands of the majority of scientists by setting up a board of qualified men and by making this board a check and balance to the administration without nullifying the latter responsibility to the President and Congress.

Committee for a National Science Foundation formed. *Science, vol. 103, Jan. 4, 1946, p. 11.*

The Committee for a National Science Foundation was formed at the invitation of Dr. Harold C. Urey and Dr. Harlow Shapley, on Dec. 28, 1945. They issued the following statement.

1. Federal support of research must supplement private funds.
2. Freedom of inquiry must be guaranteed under the government, no less than private enterprise.
3. Government should support research in all fields of fundamental and scientific inquiry relevant to national interest without arbitrary exclusion of any area.
4. Federally supported scientific findings should receive publication and should be dedicated to the welfare of the public.
5. Scholarships and fellowships open to all on basis of ability.

Need for National Science Legislation. *Chemical and Engineering News, vol. 24, Jan. 10, 1946, p. 70.*

Formation of Committee for a National Science Foundation at invitation of Harold C. Urey and Harlow Shapley.

S. 1720. *Science, vol. 103, Jan. 11, 1946, p. 39-44.*

Text of the new bill S. 1720.

Scientific training. Howard Meyerhoff. *Science, vol. 103, Jan. 18, 1946, p. 270-273.*

Discussion of the problem of replacement of scientific and engineering personnel lost during the war years, by arranging for their discharge from the armed forces. Gives resolution endorsed by 12 scientific organizations which outlines plans for such replacement and to insure a flow of scientific and engineering personnel to the colleges. Sets up a system for Scientific Training in lieu of Selective Service for the especially qualified.

National science foundation: will it be a practical reality or a perpetual controversy. *Science, vol. 103, Jan. 25, 1946, p. 104.*

Revised Kilgore Bill introduced in Congress. *Chemical and Engineering News, vol. 24, Jan. 25, 1946, p. 173-176.*

Since the completion of hearings on science legislation interest has continued to center on the relative merits of the Magnuson and Kilgore bills. Senator Magnuson's bill which received the most favorable comment from scientists and industry, still stands as originally patterned from the Bush Report. Senator Kilgore has made some revisions and introduced the following bill . . .

S. 1720 vs. S. 1777 *Science, vol. 103, Feb. 8, 1946, p. 161-162.*

Compromise bill. *Science, vol. 103, Feb. 15, 1946, p. 192.*

Text of new Kilgore-Magnuson bill. *Science, vol. 103, Feb. 22, 1946. p. 225-230.*

National Science Foundation: S. 1850, Final Senate bill. Howard Meyerhoff. *Science, vol. 103, Mar. 1, 1946, p. 270-273.*

Gives brief history of National Science Foundation legislation up to March 1946, with a brief analysis on compromise bill S. 1850.

Science legislation. *Chemical and Engineering News. vol. 24, Mar. 25, 1946, p. 786-789.*

Publishes texts of revised Kilgore-Magnuson bill S. 1850 and the Willis bill, S. 1777.

On the floor of the Senate. Howard A. Meyerhoff. *Science, vol. 103, Mar. 29, 1946, p. 382.*

Senate Committee on Military Affairs considered the Kilgore-Magnuson bill S. 1850 and reported it out of committee on Mar. 19. Now on the floor of Senate. Senator Thomas, member of AAAS in an address urged scientists to show greater interest in the legislation lest it die in the House.

Report on Science legislation. Physical Society of Pittsburgh. *Science, vol. 103, Mar. 29, 1946, p. 383-384.*

Statement of 12 objectives in Federal organization of agency to administer scientific research as formulated by the Physical Society of Pittsburgh.

Selective service and student personnel. Howard Meyerhoff. *Science, vol. 103, April 19, 1946, p. 479-480.*

Legislation now pending in Congress to approve the extension of selective service another nine months. Urges scientists to actively work against such legislation, and aid in the recruitment of scientific and engineering students.

Atomic energy and Science Mobilization legislation. *Chemical and Engineering News, vol. 24, April 25, 1946, p. 1027.*

An editorial giving the American Chemical Society's stand on National Science Foundation legislation as analyzed by its President Dewey, pointing out ACS favors legislation in the support of fundamental science and the education of scientists.

Statement concerning S. 1850. Committee supporting the Bush Report. *Science, vol. 103, May 3, 1946, p. 558.*

Endorsement of S. 1850 by the Committee led by Isaiah Bowman and 5000 scientists who were formerly actively supporting the Bush Report and the Magnuson bill.

The AAAS Council voted at the St. Louis meeting to support. S. 1850, by a vote of 223–10. Urged telegrams to individual senators.

Report of the Committee Supporting the Bush Report. *Chemical and Engineering News, vol. 24, May 10, 1946, p. 1214.*

ACS Directors' minutes, Atlantic City Meeting, April 7, 1946. *Chemical and Engineering News, vol. 24, May 10, 1946, p. 1224.*

Gives resolution adopted relative to stand on National Science Foundation Legislation. Not in complete sympathy with S. 1850, but feel importance of getting legislation passed is prime issue.

The Senate and S. 1850. Howard A. Meyerhoff. *Science, vol. 103, May 10, 1946, p. 589-590.*

S. 1850 to come up for Senate vote the week of May 13. James B. Conant on behalf of the AAAS composed a letter which was sent to every Senator except those who sponsored the bill. The letter tersely outlined the reasons why the National Science Foundation should be created. Text of letter included.

"The Race Against Time" *Chemical and Engineering News, vol. 24, May 25, 1947, p. 1323.*

Need of federal support of scientific research and education is so urgent that passing legislation is more important than quibbling over issues. An editorial.

Planning in Science. Vannevar Bush. *Chemical and Engineering News, vol. 24, May 25, 1946, p. 1333-1337.*

For scientists and engineers familiar with special ways of thought becoming potentially useful to the progress of peace and good will among the nations, there

are opened great new opportunities for achievement. It behooves them if they would serve fully in this future world to seek understanding of ourselves and of our companions.

H. R. 6448. Howard Meyerhoff. *Science, vol. 103, June 7, 1946, p. 687-688.*

Introduction of H. R. 6448 by Rep. Mills of Arkansas on May 15, seriously jeopardized the passage of S. 1850. Bill was referred to a subcommittee of House which held hearings. The new bill is essentially the same as the old Magnuson bill. The witnesses at the hurried hearings were essentially all former opponents of the Kilgore and Kilgore-Magnuson bill.

Scientists divided. Watson Davis. *Science, vol. 103, June 7, 1946, p. 688.*

Vannevar Bush backs the new H. R. 6448 as fulfilling the needs of the country better than any piece of legislation. Sec. of Commerce Wallace and E. U. Condon oppose the new bill. National Association of Manufacturers and Dr. Homer W. Smith of N. Y. University testified in favor of the H. R. 6448. New bill gives commercial patent rights to inventor, as opposed to S. 1850 which provides generally that federally supported research shall be freely available to the public. New bill does not distribute funds geographically, nor to non-profit organizations and does not provide for support of social science research.

Pending Legislation discussed in News and Views, ACS Washington News Bureau. *Chemical and Engineering News, vol. 24, June 10, 1946, p. 1481.*

Forum. *Science, vol. 103, June 21, 1946, p. 724.*

Why H. R. 6448 is the better bill, by Homer Smith.

Conforms with the Magnuson bill, incorporating constructive changes suggested at the Hearings. Complies with position taken by Committee supporting the Bush Report. Director is subordinate in authority to National Science Board. Social sciences not excluded but receive only limited support at present.

Why S. 1850 is the better bill. Henry A. Wallace.

Because it is in accordance with the President's recommendations. Feels H. R. 6448 will lead to an increasing monopolization of science by a small clique and will operate to the detriment of small business.

A united front for S. 1850. Robert Chambers.

Inasmuch as majority of scientists have voted to back S. 1850, he urges all to cooperate and forget the controversy between the old Kilgore and Magnuson bills, which was re-opened by the entry of H. R. 6448.

Why I am biased in favor of S. 1850. Howard A. Meyerhoff.

Support of any bill but S. 1850 creates impression of dissension among scientists. S. 1850 is the only bill that has given thought to every issue and makes an earnest effort to meet minority needs and objectives.

Science Legislation discussed in News and Views, ACS Washington News Bureau, by Al Leggin. *Chemical and Engineering News, vol. 24, June 25, 1946, p. 1629.*

Delay in enactment seems to be due, now to political prestige.

S. 1850 in the House. Howard Meyerhoff. *Science, vol. 104, July 19, 1946, p. 48.*

Senate voted 48–18 on S. 1850. Too close to party lines to be entirely satisfactory to scientists. The creation of a Division of Social Sciences in the National Science Foundation was deleted, a major casualty. House now has 3 bills under consideration: (1) H. R. 6448, the Mills Bill, (2) H. R. 6672, Celler Bill, identical with S. 1850 unamended, and (3) Senate bill S. 1850 as amended and passed by the Senate. Article urges scientists to exert pressure for passage of S. 1850 as amended.

Passage of National Science Foundation Bill discussed in Potomac Postscripts, by Lynne M. Lamm. *Chemical and Engineering News, vol. 24, July 24, 1946, p. 1885.*

Calls up questions of source of appropriations and probable extent of devotion to military ends.

"A Department of Science" *Chemical and Engineering News, vol. 14, July 25, 1946, p. 1899.*

Editorial presenting arguments for formation of Department of Science with cabinet status.

Obituary: National Science Foundation, 1946, Howard A. Meyerhoff. *Science, vol. 104, Aug. 2, 1946, p. 87-88.*

National Science Foundation bill died July 19, 1946. Tabled by Committee on Interstate and Foreign Commerce because "legislation was too complicated and important" for action with information at hand. Responsibility for introduction of H. R. 6448 given to Dr. Bush and his following. It was the entrance of this bill on the scene which undoubtedly resulted in the failure of S. 1850 to pass the House. Suggests reason for failure of passage was really inability of scientists to get together on one piece of legislation.

Science legislation reviewed in News and Views, ACS Washington News Bureau. *Chemical and Engineering News, vol. 24, Aug. 10, 1946, p. 2005.*

Bill died in House Interstate Commerce Committee on July 19.

Support for S. 1850. *Science, vol. 104, Aug, 15, 1946, p. 161.*

Otto Stern, Emeritus Professor of Carnegie Institute of Technology calls attention to the dangers in the present broad-scale sponsoring of university research by military agencies and pointed out the necessity for speedy enactment of a National Science Foundation Bill.

Government research discussed by Al Leggin in News and Views, ACS Washington News Bureau. *Chemical and Engineering News, vol. 24, Aug. 25, 1946, p. 2156.*

Lists major appropriations of nearly a billion dollars passed by Congress to various research agencies, although the National Science Foundation failed to pass.

Research board discussed by Al Leggin in News and Views, ACS Washington News Bureau. *Chemical and Engineering News, vol. 24, Oct. 25, 1946, p. 2741.*

Although Congress stymied National Science Foundation, President Truman has established a Presidential Research Board to promote the most effective allocation of research resources between universities, research foundations, and industry to prevent the overlapping of Federal research work.

A National Science Foundation. Philip N. Powers. *Science, vol. 104, Dec. 27, 1946, p. 614-619.*

A survey presenting the main issues of the Science Foundation controversy, the manner in which these issues are being partially resolved, and giving in chronological order, the outstanding developments in Science Foundation legislation during the years 1945–46. Gives origin of Office of Naval Research and compares its expenditures for the first year with estimates in the Bush Report for the expenditures of a National Science Foundation. Shows need for discovery and development of scientific talent. Excellent survey.

A National Science Foundation? If so, What? *Chemical and Engineering News, vol. 25, Jan. 27, 1947, p. 223.*

An editorial giving brief history of Science Foundation legislation. Invites readers to submit their views, in hope that major differences can be resolved. An attempt to develop possible new approaches, possibly a new solution to one of the most serious problems confronting the U. S. today.

Two bills providing for a National Science Foundation were introduced into the Senate on Friday, February 7 . . . *Science, vol. 105, Feb. 14, 1947, p. 171.*

The first bill S. 525, introduced by Senator Elbert D. Thomas, of Utah is identical with S. 1850 which passed the Senate in the last Congress. The other is S. 526, introduced by Senator Alexander Smith of New Jersey, a compromise measure which provides for the creation of a National Science Foundation composed of 48 outstanding scientific leaders appointed by the President. They would

delegate power to an Executive committee of 9, who in turn would select a Director. Inclusion of social sciences left to judgment of Foundation. Provides for distribution of funds by states. Jan. 14, Rep. Celler introduced a bill in the House, H. R. 942, which is identical with S. 1850 of last session. Simultaneously on Feb. 10, Rep. Case, Mills, and Priest introduced into the House bills now numbered H. R. 1815, 1830, 1834, all identical with Smith bill S. 526, in the Senate.

Science was informed on Feb. 25, that the hearings on House Bills for a National Science Foundation, H. R. 942, 1815, 1830, 1834, will be held on Mar. 6 and 7. *Science, vol. 105, Feb. 28, 1947, p. 227.*

The permanent officers of the Inter-Society Committee for a National Science Foundation were elected . . . *Science, vol. 105, Feb. 28, 1947, p. 227.*

Edmund Day of Cornell University elected chairman. Meeting devoted to frank discussion of two proposals in Congress. All, in general, approve of National Science Foundation. The War Department representatives issued a statement outlining their position: (1) specifically interested in the maintenance of strongest national scientific research program. (2) Essentially in favor of a National Science Foundation as it seems best way of achieving this. (3) Administrative organization of such agency must contain provisions that are acceptable to industry. (4) Would be better to ignore patent provisions, than endanger the close relationship of industry and the war department. (5) War department must be free to let research contracts where it deems best, would like to use a National Science Foundation to monitor such contracts. (6) Defense research would vary from year to year, and it would be a mistake to specifically limit amount of defense research. (7) Specifically favor a form of legislation which would allow it to perform functions and continue relationships as outlined above,

Science Foundation bills. *Chemical and Engineering News, vol. 25, Mar. 3, 1947. p. 600-609.*

Presents complete text of three bills to establish National Science Foundation, which have recently been introduced in Congress: S. 525 (Thomas bill) S. S. 526 (Smith bill) and H. R. 942 (Celler bill) In addition to those presented here, three other bills identical to S. 525 have also been introduced. They are H. R. 1815, by Mr. Case of N. J., H. R. 1830, by Mr.Mills of North Dakota, and H. R. 1843 by, Mr. Priest of Tennessee.

Comparison of the provisions of S. 525 and S. 526. *Science, vol. 105. No. 2723, Mar. 7, 1947, p. 253-254.*

Gives details of bills in outline form.

Late Friday, Mar. 7, the Interstate and Foreign Commerce Committee of the House ended the current hearings on the National Science Foundation bills. *Science, vol. 105, Mar. 14, 1947, p. 277.*

Frank B. Jewett only witness to oppose Foundation. He felt present shortage of private funds due to income tax laws. Change in tax laws would result in sufficient private funds for research. Pres. Conant felt that entirely too much emphasis was being placed on organization and administration. He personally would accept any of the bills. Scholarships to attract gifted students to scientific study was the paramount issue. Edmund Day stated there was a widespread feeling among scientists that the caliber of men chosen to direct the National Science Foundation was more important than administrative procedure. Should not be so specific in details of procedure as to hamper carrying out of objectives.

(To be continued)

Truth is inclusive of all the virtues, is older than sects or schools, and like charity more ancient than mankind.

AMOS BRONSON ALCOTT

PROBLEM DEPARTMENT

CONDUCTED BY G. H. JAMISON
State Teachers College, Kirksville, Mo.

This department aims to provide problems of varying degrees of difficulty which will interest anyone engaged in the study of mathematics.

All readers are invited to propose problems and to solve problems here proposed. Drawings to illustrate the problems should be well done in India ink. Problems and solutions will be credited to their authors. Each solution, or proposed problem, sent to the Editor should have the author's name introducing the problem or solution *as on the following pages.*

The editor of the department desires to serve its readers by making it interesting and helpful to them. Address suggestions and problems to G. H. Jamison, State Teachers College, Kirksville, Missouri.

SOLUTIONS AND PROBLEMS

Note. Persons sending in solutions and submitting problems for solutions should observe the following instructions.

1. Drawings in India ink should be on a separate page from the solution.

2. Give the solution to the problem which you propose if you have one and also the source and any known references to it.

3. In general when several solutions are correct, the ones submitted in the best form will be used.

Late Solutions

2047, 53. *L. S. Russell, Walnut Creek, Calif.*

2053. *Laverne Wenzelman, Grasplake, Ill.*

2054, 6. *M. Kirk, Philadelphia.*

2042, 52, 3, 6, 8, 5. *Francis L. Miksa, Aurora, Ill.*

2047, 9, 57, 8. *C. W. Trigg, Los Angeles City College.*

2047, 9, 58. *Gene Archer, Dallas, Texas.*

2057. *V. C. Bailey, Evansville, Ind.*

2047, 53, 4, 8. *Frank Sevier, Philadelphia.*

2054, 5, 8. *Alen Wayne, Flushing, L. I., N. Y.*

2059. *Proposed by Bessie Spillman, Dobbs' Ferry, N. Y.*

In triangle ABC if $\angle B = 45°$, show that $(1+\cot A)(1+\cot C) = 2$.

Solution by W. R. Talbot, Jefferson City, Mo.

If $B = 45°$, $A = 135 - C$ and

$$\cot A = \cot (135 - C) = \frac{1-\cot C}{1+\cot C},$$

by easy trigonometry. Then, by multiplying and substituting

$$(1+\cot C)(1+\cot A) = (1+\cot C + (1+\cot C)\cot A = 1+\cot C+1-\cot C = 2.$$

Solutions were also offered by J. P. Ludington, Irvington, N. Y.; Francis L. Miksa, Aurora, Ill.; Margaret Joseph, Milwaukee, Wis.; C. W. Trigg, Los Angeles City College; Felix John, Ammendale, Md.; Aaron Buchman, Buffalo, N. Y.; Don Spaan, Iowa City; George R. Lewis, Clarion, Pa.; H. Saffen, Ithaca, N. Y.; Max Beberman, Nome, Alaska; and the proposer.

2060. *Proposed by Hugo Brandt, Chicago.*

Show that 2^r is a factor of $(2^n)!$, where $r=2^n-1$.

Solution by Aaron Buchman, Buffalo, N. Y.

Every second factor of the product, $(1)(2)(3)\cdots(2^n)$ is divisible by 2. Therefore, 2 occurs as a factor of this product *at least* 2^{n-1} times.

Every fourth factor of the product, $(1)(2)(3)\cdots(2^n)$ is divisible by 4. Therefore, 2 occurs as a factor of this product *at least* $2^{n-1}+2^{n-2}$ times.

Proceeding in this manner, it is easily shown that 2 occurs as a factor of the product, $(1)(2)(3)\cdots(2^n)$, exactly $2^{n-1}+2^{n-2}+2^{n-3}+\cdots+2^0$ times.

But the sum,

$$2^{n-1}+2^{n-2}+2^{n-3}+\cdots+2^0=\frac{2^n-1}{2-1}=2^n-1.$$

Therefore 2^r is a factor of $(2^n)!$, where $r=2^n-1$.

Other solutions were offered by Felix John, Ammendale, Md.; Francis L. Miksa, Aurora, Ill.; W. R. Talbot, Jefferson City, Mo.

2061. *Proposed by Clarence R. Perisho, McCook, Nebraska.*

Show that $n!$ is divisible by a^b, where a and b are integers and b is approximately equal to $n/(a-1)$ for large values of n.

Solution by the Proposer

$n!$ contains approximately n/a multiples of a and n/a^2 multiples of a^2 etc. so that the total number of times a is a factor is approximately $(1/a+1/a^2+1/a^3+\cdots)n$ or, since the expression the parentheses is a geometric progression it is approximately equal to $n/(a-1)$ as n increases without limit.

Solutions were also offered by Aaron Buchman, Buffalo, N. Y. and W. R. Talbot, Jefferson City, Mo.

2062. *Proposed by Ernest Van Riper, Romulus, N. Y.*

Solve:

$$x+xy^2=18$$
$$xy+xy^2=12.$$

Solution by John A. Beemster, Epworth, Iowa

Given:

$$x+xy^2=18 \tag{1}$$
$$xy+xy^2=12 \tag{2}$$

Factoring (1),

$$x(1+y^2)=18$$

whence

$$x=\frac{18}{1+y^2}. \tag{3}$$

Substituting (3) in (2),

$$\frac{18y}{1+y^3}+\frac{18y^2}{1+y^3}=12.$$

Simplifying,

$$18y+18y^2=12+12y^3$$

or,

$$2y^3-3y^2-3y+2=0.$$

Factoring:

$$(2y-1)(y+1)(y-2)=0$$

whence

$$2y-1=0, \text{ and } y=\tfrac{1}{2}$$
$$y+1=0, \text{ and } y=-1$$
$$y-2=0, \text{ and } y=2.$$

Substituting these values in (3) gives,

$$x=2$$
$$x=\text{non-existent value}$$
$$x=16 \text{ respectively.}$$

Other solutions were offered by W. R. Smith, Pass-A-Grille Beach, Fla.; Margaret Joseph, Milwaukee, Wis.; W. R. Talbot, Jefferson City, Mo.; G. R. Lewis, Clarion, Pa.; L. S. Russell, Walnut Creek, Calif.; J. W. Lindsey, Amarillo, Texas; Francis L. Miksa, Aurora, Ill.; H. C. Wholihan, Detroit, Hobart Boler-jack, Benton Harbor, Mich.; R. T. Ashbaugh, Longmont, Colo.; Felix John, Ammendale, Md.; Aaron Buchman, Buffalo; Don Spaan, Iowa City, Ia.; H. Saffen, Ithaca, N. Y.; S. E. Field, Ironwood, Mich.; Max Beberman, Nome, Alaska.

2063. *Proposed by Brother Felix John, Philadelphia, Pa.*

If R and r are circumradius and in-radius of triangle ABC prove that

$$\frac{1}{2Rr}=\frac{1}{ab}+\frac{1}{bc}+\frac{1}{ac}.$$

Solution by Francis L. Miksa, Aurora, Ill.

From trigonometry we have the following two relations

$$\frac{1}{2R}=\frac{\sin A}{a} \tag{1}$$

$$\sin A=\frac{2sr}{bc} \tag{2}$$

$$\frac{1}{2R}=\frac{2sr}{abc} \qquad 2s=a+b+c \tag{3}$$

$$\frac{1}{2Rr}=\frac{a+b+c}{abc}+\frac{1}{bc}+\frac{1}{ab}+\frac{1}{ac}. \tag{4}$$

Solutions were also offered by M. Kirk, Philadelphia; C. W. Trigg, Los Angeles City College; Aaron Buchman, Buffalo; W. R. Talbot, Jefferson City, Mo.; S. E. Field, Ironwood, Mich.; and the proposer.

2064. *Proposed by Belle Conley, Newark, N. J.*

If n is a positive integer show that $7^{2n+1}+1$ is divisible by 8.

Solution by Felix John, Ammendale, Md.

Since $2n+1$ is an odd integer, $7^{2n+1}+1$ is the sum of two odd powers.

$$\therefore 7^{2n+}+1=(7+1)(7^{2n}-7^{2n-1}+7^{2n-2}\cdots 7+1)$$

$$=8 \text{ times an integer.}$$

Solutions were also offered by Hobart Bolerjack, Benton Harbor, Mich.; C. W. Trigg, Los Angeles; Aaron Buchman, Buffalo; W. R. Talbot, Jefferson City, Mo.; H. Saffen, Ithaca, N. Y.; S. E. Field, Ironwood, Mich.; Max Beberman, Nome, Alaska; Francis L. Miksa, Aurora, Ill.

2042. *Proposed by Hugo Brandt, Chicago.*

If $x+t+u=9$, $u>0$ and if $m=(10t+u)$, then show that $987654321m$ is a number of from 10 to 12 digits, in which the digits of the 12th, 11th and 1st place are the digits of m in the same order. Also show that the remaining nine digits are the same and equal to x.

Solution by C. W. Trigg, Los Angeles City College

1. Represent 987654321 by N and Nm by P. If $t=0$ and $u=1$, $P=N$ and contains nine digits. If $10\geq m>1$, P contains 10 digits. If $m=11$, $P=10864197531$. Since $u>0$, the maximum value of m is 81, to which corresponds $P=8\ 000\ 000\ 000\ 1$. Therefore if m contains two non-zero digits, P contains precisely eleven digits.

2. Since the unit's digit of N is 1, the unit's digit of P is $1\times u$ or u. Now

$$P=(10t+u)N=(10t+u)(10^9-12345679)$$

$$=10^{10}t+10^9u-(10t+u)(12345679).$$

For any digit values of $u>0$ and t, the negative term above is less than 10^9u. Hence, the algebraic sum of the last two terms cannot affect the eleventh digit of P. It follows that the eleventh digit and the first digit of P are the digits of m in the same order.

3. Since any integer is congruent to the sum of its digits modulo 9, $N\equiv 45\equiv 0 \pmod 9$, so $P\equiv 0 \pmod 9$. If the proposition be true, $P=txxx\ xxx\ xxx\ u$, so $P\equiv t+u+9x\equiv t+u \pmod 9$. Hence, $t+u\equiv 0 \pmod 9$. But it is given that $t+u+x\equiv 0 \pmod 9$, so $x\equiv 0 \pmod 9$. Hence, $x=0$, for if $u>0$ the maximum possible value of x is 8.

4. In the multiplication $N\times m$, the product of their unit's digits is u, so there is no carry over to affect the ten's digit of P. Therefore, the ten's digit of P establishes one of the relationships:

	$2u+\ t=x$	or	$2u+\ t=\ x+10$
but	$u+\ t=-x+9$		$u+\ t=-x+\ 9$
so	$3u+2t=9$	or	$3u+2t=19.$

Now the only integer solutions of these equations for $9\geq u>0$ are

$$u=1,\ t=3,\ x=5 \qquad u=1,\ t=8,\ x=0$$

$$u=3,\ t=0,\ x=6 \qquad u=3,\ t=5,\ x=1$$

$$u=5,\ t=2,\ x=2$$

Thus the only solution meeting the requirement of (3) gives $x=0$, $m=81$. So $P=8\ 000\ 000\ 000\ 1$ is the only value meeting the requirement "that the remaining nine digits are the same and equal x." The proposition in general is not true.

5. The product P of N by a two-digit integer, $y(=10a+b)$, $b\neq 0$, $y\neq 91$, exhibits the following characteristics:

5-1. We may consider all values of P as eleven digit integers by admitting zero as a permissible eleventh digit. Then the eleventh digit of P is a and the first digit is b.

5-2. For $0<y\leqq 81$, the eleventh and tenth digits taken together equal $y-1$, so the tenth digit is $b-1$. For $81<y\leqq 99$, the eleventh and tenth digits taken together equal $y-2$, so the tenth digit is $b-2$. Examples: $06N=05925925926$, $45N=4\ 444\ 444\ 444\ 5$, $93N=91851851853$.

5-3. If $y\not\equiv 3 \pmod 9$, the nine intermediate digits consist of a cyclic permutation of one of the sets

012345679, 024691358, 049382716,

061728395, 086419753, 098765432.

These sets are multiples of the first (basic) set by $r=1, 2, 4, 5, 7, 8$ respectively. Which set appears is determined by the congruence $r+y\equiv 0 \pmod 9$.

Said otherwise, each set consists of the ten digits with one missing, the missing digit being equal to $a+b$. Thus P may be written without actual multiplication for any y by determining r and entering the corresponding set with $b-1$ or $b-2$ as required by properties 5-1 and 5-2. Example: $y=47, r=7, yN=4\ 641\ 975\ 308\ 7$.

5-4. If $y\equiv 3$ or $y\equiv 6 \pmod 9$, the nine intermediate digits consist of three like triads. Every triad is a cyclic permutation of one of the sets 037, 074, 148, 185, 259, 296. These sets are multiples of the first (sub-basic) set by $s=1, 2, 4, 5, 7, 8$ respectively. [The three triads considered together constitute a multiple of the basic set by $3r$]. The triad which appears depends upon the congruence $3s+y\equiv 0 \pmod 9$. P may be written without complete multiplication since the units' digit of the triad is determined by $2b+a$ and the hundred's digit is $b-1$ or $b-2$ (see 5-2).

5-5. If $y\equiv 0 \pmod 9$ the nine intermediate digits are like digits, each equal to $b-1$ or $b-2$, and also determined by $2b+a$.

5-6. Every set of intermediate digits is a multiple of 012345679.

5-7. P for $y=91$ and for $b=0$ may be "forced" to conform to the above properties by subtracting unity from the ten's digit of P and adding unity to the eleventh digit.

HIGH SCHOOL HONOR ROLL

The Editor will be very happy to make special mention of high school classes, clubs, or individual students who offer solutions to problems submitted in this department. Teachers are urged to report to the Editor such solutions.

Editor's Note: For a time each high school contributor will receive a copy of the magazine in which the student's name appears.

For this issue the Honor Roll appears below.

2053. *C. J. McCombe, H. F. Trotter, Robert A. White, and D. K. Wilson, all from Upper Canada College, Toronto.*

2062. *Don Spaan, Don Waller, B. M. Tyndall, all from Iowa City High School.*

2064. *John P. Lazarus, Iowa City High School.*

2063. *Phil Marsh, Craig Mohaffy, Milton Forbes, all from Iowa City High School.*

PROBLEMS FOR SOLUTION

2077. *Proposed by W. S. Pemberton, Brookfield, Mo.*

In triangle ABC, with angle $B=90°$, with C as center and $AC/2$ as radius cut BC at D. Find the relations between AB and BC so that $BD/DC=DC/BC$.

2078. *Proposed by Frederic E. Neinmers.*

Prove that the line joining one focus of an ellipse with the end point of the latus rectum drawn through the other focus is greater than the semi-major axis.

2079. *Proposed by Belle Conley, Newark, N. J.*

Without the use of logarithms, find x if $2^{x^2}:2^{2x}=8:1$.

2080. *Proposed by Anna Campbell, Geneva, N. Y.*

If a, b, c are roots of $x^3+qx+r=0$, form the equation whose roots are

$$\frac{b+c}{a^2},\quad \frac{c+a}{b^2},\quad \frac{a+b}{c^2}.$$

2081. *Proposed by Norman Auning, University of Mich.*

What number must be marked in the row: 1, 2, 3, $\cdots$, 287, 288 so that the sum of the numbers on one side of it shall equal the sum on the other side? Find the next number greater than 288 such that a similar problem can be made about it.

2082. *Proposed by Glendale Wallace, Stockton, Calif.*

Solve:

$$(x+1)(x+2)(x+3)(x+4)=24.$$

THE QUIZ SECTION

JULIUS SUMNER MILLER
Dillard University, New Orleans 19, Louisiana

1. In a motion picture the spokes of a rotating wheel sometimes appear to be moving the wrong way. Why?
2. Explain how a man standing on a swing can increase his amplitude by crouching at suitable times?
3. A hoop of mass M and radius $R/\sqrt{2}$ and a circular plate of mass M and radius R are enclosed in *identical* boxes. Can these be distinguished, and how? (Note that these bodies are equimomental.)
4. The sharper the edge of a package or parcel the greater the tendency for the string binding it to cut into it. Show this analytically.
5. A man is aboard an escalator. The escalator does work on the man. Does it make any difference whether the man stands still or runs up or down, slow or fast?
6. A cord can sustain a load of F pounds at rest. Find the least time in which a load of W pounds can be lifted a height H.
7. Boys are playing hockey on an icy street. The puck slides along the icy pavement and hits a bare spot. Will it tip up or not?

HOFFMAN TELLS OF EDUCATIONAL CONDITIONS

Congressman Clare E. Hoffman writes that "It is a lamentable fact that the United States will spend far less on public education in 1948 than it will spend abroad in foreign relief and reconstruction. . . . As measured by today's wage standards in other occupations, most of our teachers are deplorably underpaid. Too many of our school buildings, both urban and rural, are crowded far beyond accepted American standards of health, comfort and convenience. . . . As a member of the Committee on Education and Labor, I say Congress would do well to give first attention—and first appropriations—to America's urgent needs at home, particularly in the field of public education."—Congressman Hoffman is also chairman of the important House Committee on Expenditures in the Executive departments.

BOOKS AND PAMPHLETS RECEIVED

ENERGY UNLIMITED, The Electron and Atom in Everyday Life, by Harry M. Davis, *Science Editor of Newsweek*. Cloth. Pages xiv+273. 14×21 cm. 1947. Murray Hill Books, Inc., 232 Madison Avenue, New York 16, N. Y. Price $4.00.

COLLEGE ALGEBRA, by Frederick S. Nowlan, Ph.D., *Professor of Mathematics, University of British Columbia (Visiting Professor, University of Illinois, Chicago Undergraduate Division, 1947–48)*. Cloth. Pages xiv+371. 14.5×23 cm. 1947. McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York 18, N. Y. Price $3.00.

OLD WORLD LANDS, by Harlan H. Barrows, *Department of Geography, University of Chicago;* Edith Putnam Parker, *Department of Geography, University of Chicago;* and Clarence Woodrow Sorensen, *Traveler and Geography Lecturer*. Cloth. Pages v+346. 20×27 cm. 1947. Silver Burdett Company, 45 E. 17th Street, New York, N. Y. Price $2.88.

CHEMICAL CALCULATIONS, by Bernard Jaffe, *Chairman of the Department of Physical Sciences, James Madison High School, Brooklyn, New York*. Revised. Cloth. Pages xii+180. 13×18.5 cm. 1947. World Book Company, Yonkers-on-Hudson, New York. Price $1.60.

DAVISON'S MAMMALIAN ANATOMY, WITH SPECIAL REFERENCE TO THE CAT. Revised by Frank A. Stromsten, D. Sc., *Associate Professor of Zoology, University of Iowa*. Seventh Edition. Cloth. Pages xi+349. 15×23 cm. 1947. The Blakiston Company, 1012 Walnut Street, Philadelphia 5, Pa. Price $4.25.

THE STRANGE STORY OF THE QUANTUM, by Banesh Hoffmann, *Department of Mathematics, Queens College, New York*. Cloth. Pages xi+239. 13.5×20.5 cm 1947. Harper and Brothers, 49 E. 33rd Street, New York 16, N. Y. Price $3.00.

ELEMENTARY CONCEPTS OF MATHEMATICS, by Burton W. Jones, *Professor of Mathematics, Cornell University*. Cloth. Pages xiii+294. 13.5×21.5 cm. 1947. The Macmillan Company, 60 Fifth Avenue, New York, N. Y., Price $4.00.

INTERMEDIATE ALGEBRA, by Ralph S. Underwood, *Professor of Mathematics, Texas Technological College;* Thomas R. Nelson, *Associate Professor of Mathematics, Agricultural and Mechanical College of Texas;* and Samuel Selby, *Head of the Department of Mathematics, College of Engineering, University of Akron*. Cloth. Pages vii+283. 13×20.5 cm. 1947. The Macmillan Company, 60 Fifth Avenue, New York, N. Y. Price $2.60.

WORKBOOK IN GENERAL MATHEMATICS: BASIC COURSE, by Raleigh Schorling, John R. Clark, and Francis G. Lankford, Jr. Kraft. 162 pages. 21×26 cm. 1948. World Book Company, Yonkers-on-Hudson, N. Y. Price 68 cents.

LABORATORY CHEMISTRY, by William E. Price, *Department of Chemistry, Clifford J. Scott High School, East Orange, New Jersey*. Kraft. Pages x+133. 21×26 cm. 1947. World Book Company, Yonkers-on-Hudson, N. Y. Price 92 cents.

INORGANIC CHEMICAL NOMENCLATURE, by Lloyd McKinley, *Professor of Chemistry, University of Wichita*. Paper. 40 pages. 21×27.5 cm. 1947. University of Wichita Bookstore, Wichita, Kansas. Price 35 cents. In lots or more 28 cents.

ARITHMETIC, Compiled and Edited by G. T. Buswell. Paper. Pages v+73. 16.5×24 cm. 1947. The University of Chicago Press, 5750 Ellis Avenue, Chicago 37, Ill. Price $1.50.

LESSONS IN ARITHMETIC THROUGH SCHOOL SAVINGS; ELEMENTARY GRADES—ACTIVITIES, PROBLEMS, AND TECHNIQUES, by Irene N. Reid, *Miner Teachers College, Washington, D. C.* Paper. Pages ii+25. Published by the Education

Section of the U. S. Savings Bonds Division, Treasury Department, Washington, D. C.

BETTER TEACHING THROUGH THE USE OF CURRENT MATERIALS. A Report on an Eighteen-Month Study in English, Science, and Social Studies Classes by The California Council on Improvement of Instruction January 1946 to June 1947. Prepared by Lucien Kinney, and Reginald Bell, *Stanford University School of Education*. Paper. 24 pages. 17×23 cm.

SCHOOL AND WORK PROGRAMS. A Study of Experience in 136 School Systems, by Caroline E. Legg, Carl A. Jessen, and Maris M. Proffit, Pages vi+59. 15×23 cm. Bulletin 1947, No. 9. Superintendent of Documents, U. S. Printing Office, Washington, D. C. Price 20 cents.

EDUCATION IN GUATEMALA, by Cameron D. Ebaugh, *Senior Specialist on Education in Latin American Countries, American Republics Section, Division of International Educational Relations*. Bulletin 1947, No. 7. Pages vi+82. 14.5×23 cm. Superintendent of Documents, Washington D. C. Price 25 cents.

CROW ROTATING ELECTRIC MACHINE, by Col. Kenneth Zitzman, *Signal Corps, U. S. Army, Associate Professor, Department of Electricity of the United States Military Academy, West Point, New York*. Paper. Manual of 94 pages. 20.5×28 cm. 1947. Universal Scientific Company, Inc., 1102 Shelby Street, Vincennes, Ind.

FOUNDATIONS OF PHYSICS, by Geo. P. Unseld, *Instructor in Physics, West High School, Salt Lake City, Utah*. Volume I, 121+xii pages. Volume II, 144+xii pages. Paper. 20×27.5 cm.

BOOK REVIEWS

MATERIALS OF INDUSTRY, by Samuel Foster Mersereau, *One time chairman, Department of Industrial Processes, Brooklyn Technical High School*, and revised by Calvin C. Reen, *Professor of Engineering Extension, The Pennsylvania State College*, and Kenneth L. Holderman, *Associate Professor and Assistant Director of Engineering Extension, The Pennsylvania State College*. Fourth Edition, Cloth. Pages xxiii+623. 13.5×20 cm. 1947. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York, 18, N. Y. Price $2.80.

The authors present all the important materials of industry and their methods of manufacture and distribution. The respective chapters deal with Forest Products, Non-metallic Minerals, Iron and Steel, and Non-ferrous Metals. Chapter V handles the newer products such as rubber, plastics, paints, stones, and varnishes. It also includes a film list on the above topics.

Although designed for a course of study as developed in the Brooklyn Technical High School, teachers of general shop or industrial arts will find the book useful for both personal and class reference.

KENNETH E. ANDERSON

LECTURE EXPERIMENTS IN CHEMISTRY—3RD EDITION WITH SUPPLEMENT, by G. Fowles, M. Sc., A.R.I.C., F.C.S. (England). Third Edition. Cloth. Pages xvi+612. 13.5×21.0 cm. 1947. The Blakiston Company, 1012 Walnut Street, Philadelphia 5, Pa. Price $7.00.

This book is one that might well be used as a source book for both the experienced and inexperienced teacher, whether he be a high school instructor or a college instructor. Mr. Fowles points out that a well done lecture experiment is not an offense against the scientific method. In fact, he attempts in Chapter III, to show how to inculcate the scientific method in actual investigations carried out jointly by the teacher and his class.

Mr. Fowles gives several excellent hints on how to perform lecture experiments—ones that even the most experienced teacher might profit from.

The text outlines in detail, 607 demonstration experiments, most of which require only the simplest of apparatus. Each experiment has a definite teaching purpose. For example, Experiment 72 clinches the distinction between a mixture and a compound.

Chapter V stresses the physical principles underlying chemical action such as mass action, hydrolysis, and catalysis.

The appendices contain excellent discussions on several important topics: The aims and methods of teaching chemistry, mechanical aids to lecturing, and reagents for the lecture bench.

KENNETH E. ANDERSON

ONE STEP PROBLEM PATTERNS AND THEIR RELATION TO PROBLEM SOLVING, by Ethel Sutherland, Ph.D. *Teachers College, Columbia University.* Contributions to Education, N. 925. Cloth. 170 pages. 15×22.5 cm. 1947. Bureau of Publications. Teachers College, Columbia University, New York, N. Y. Price $2.35.

A systematic attack upon the solution of arithmetic verbal problems in grades 3 through 6. This study is similar in nature to the work of Thorndike in the field of arithmetic computation.

Four text series following the same state course of study were examined. Single step procedures of addition, subtraction, multiplication, and division were set up on the basis of their use in verbal problems. Out of over 15,000 problems considered, 38 one step patterns were formed. These were then tabulated for each text as to frequency of use.

It was found that the texts all had a marked consistency in relation to the use of these basic patterns, with multiplication, division, subtraction, and addition being their relative frequency of use ranking. Sufficient coverage was found to be provided by each text series, with possible over use of multiplication in some instances.

The results of this study are recommended for use by teachers and supervisors of arithmetic, instructors of methods, authors of texts and tests, and curricula planners. They are certainly not suitable for use as pupil techniques, but provide a check and guide in the type of problems to be used. A related study has shown that concentration upon basic problem types will result in a marked improvement for the solution of related forms. However, this study seems to offer an opening attack upon the problem, rather than to provide a "cure-all" for problem solving difficulties in arithmetic.

W. K. MCNABB
Hockaday Junior College
Dallas, Texas

THE NAMING OF THE TELESCOPE, by Edward Rosen, *The City College of New York.* Cloth. Pages xiv+110. 12.5 × 18.5 cm. Henry Schuman, Publisher, 20 E. 70th St. New York 21, N. Y. 1947. Price $2.50.

This small volume is a study in the early history of the telescope which reveals how the instrument got its name. On the basis of the documents discussed in the text, the author reaches the conclusion that the term *telescope* was originally devised by John Demisiani of Cephalonia and publicly unveiled by Frederick Cesi, founder and president of the Academy of the Lynxes (an association for the advancement of science, whose most illustrious member was Galileo), at a banquet in Galileo's honor on April 14, 1611. As Dr. Harlow Shapley states in his foreword: "From the standpoint of the users of telescopes," and of others interested in this subject, "this is a most attractive treatise by an expert . . . (who) made a seemingly small subject noble and exemplary." This investigation of the naming of the telescope sheds a clearer light on one branch of the history of the

development of science. The inclusion of some portraits and signatures of the people named in this study adds a note of interest and instruction.

LOUIS PANUSH
Central High School
Detroit, Michigan

INTERMEDIATE ALGEBRA by H. L. Rietz, Late of *The University of Iowa;* A. R. Crathorne, Late of *The University of Illinois;* and L. J. Adams, *Santa Monica City College.* Cloth. Pages x+294, 14×21 cm. 1947. Henry Holt and Company, New York. Price $2.40.

"Intermediate Algebra" is a revision by Professor L. J. Adams of "Intermediate Algebra" by Rietz, Crathrone and Adams written and published in 1942. The main feature of the revision is the addition of a large number of practical problems and exercises selected to illustrate the applications of algebra in physical sciences, engineering and analytic geometry.

"Intermediate Algebra" includes in addition to the usual topics a very good development of ratio and proportion, variation, mathematical induction and binomial theorem, extension of the number concept and solution of systems of linear equation by determinants. It is written for use by high school or college students who have had one year of high school algebra. The first chapter offers a simple and concise review of elementary concepts and principles. The development of advance topics given in the succeeding chapters are brief, direct and concise followed by a large number of carefully graded exercises and problems, which deal with scientific and engineering laws, principles and formulas.

The book provides no test program although review and miscellaneous problems and exercises are given at the conclusion of certain chapters. One page is devoted to tables of powers, roots and reciprocals of numbers one to one hundred. Answers are printed for odd-number problems.

DOYLE T. FRENCH
Elkhart High School
Elkhart, Ind.

PRECISION SHOP MATHEMATICS, by William Herbert Edwards, M.A., *Redford High School, Detroit Michigan.* Cloth. Pages v+314. 15×22 cm. 1947. D. C. Heath and Company, 285 Columbus Avenue, Boston 16, Mass. Price $2.48.

This book may be used as a class text, as a guide for independent study or as a shop mathematics reference book. The eight units into which it is divided are so written and arranged that it is not necessary to study them in the order in which they are given. To fully understand the book the reader should have some knowledge of algebra, geometry, and trigonometry as well as contact with shop machines and gages which are mentioned in the text.

The presentation of the problems is a little unusual and is especially well adapted to this type of mathematics. The problem is stated and explained and an illustrative example, complete with the necessary figures is worked for the student. Then the assignment of problems together with the necessary figures is given. The author recommends that "the instructor grade each exercise and repeatedly return the assignment—for correction until the assignment is one hundred per cent correct." Since precision in shop work is essential, it would seem that this procedure would improve the accuracy of the student.

Illustrations and figures are numerous and appear not only to be well drawn but also to be well chosen. The number of exercises in the assignments is sufficiently large that the instructor can provide for individual abilities by a change in the number of exercises assigned. Although your reviewer is not especially interested in shop work, this book appeals to him as being a very practical book from the standpoint of machine shop students, operators, or technicians.

ALBERT R. MAHIN
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Indianapolis 20, Indiana

BUSINESS ARITHMETIC, by George H. van Tuyl, *Formerly Teacher Evander Childs High School, City of New York, and Instructor School of Commerce Accounts, and Finance, New York University.* Cloth. Pages ix+352. 12×18 cm. 1947. American Book Company, 88 Lexington Avenue, New York 16, N. Y. Price $1.64.

This is a textbook which may be used for either business or general arithmetic. It is divided into two parts each of which is a semesters' work. Part I is divided into sixty lessons, or topics. It includes prognostic and diagnostic tests as well as remedial drill. The many topics of these lessons provide a thorough review and drill in the fundamental processes of arithmetic as they apply to whole numbers, fractions and decimals. The method of presentation is very good, and emphasis is placed upon the mathematics vocabulary as well as problem solving.

Part II is divided into fourteen chapters for which the following are the subjects: Ratio and Proportion; Denominate Numbers; Graphs; Percentage; Interest; Taxes; Insurance; Investments; Partnership; Review Tests; Federal Income Taxes; Federal Social Security; Buying and Selling on Credit; and Cooperatives. These topics provide a good survey of the problems of business. There are enough problems both in part II and part I so that the teacher can make due allowance for individual differences.

One statement of the author in the introduction gives a key to his general philosophy in this book. He says, "Unfortunately, many people think that, because calculating machines are in common use, it is not necessary to study arithmetic. No machine can solve a problem or call a column of numbers without human direction. Intelligent use of a calculating machine requires the operator to have a superior knowledge of the principles of arithmetic." Your reviewer believes that the conscientious student who studies *Business Arithmetic* will be better qualified as a business mathematician.

ALBERT R. MAHIN

ANALYTIC GEOMETRY, by Paul R. Rider, Ph.D. Professor of Mathematics, *Washington University, St. Louis, Mo.* Cloth. Pages x+383. 14×20.5 cm., 1947, Macmillan Co., 60 Fifth Avenue, New York, New York. Price, $3.25.

This text is the result of the author's use of the material over several years. It covers the standard topics found in most Analytic Geometry texts including SPACE ANALYTIC GEOMETRY. There are several chapters not found in the standard text. Chapter 12, "Curve Fitting," which is a brief but to the point discussion on uses of curves as applied to statistics and rates of growth. It gives the development of regression lines, coefficient of correlation, and exponential curves. Another interesting chapter is number 8, "Curve Sketching," in which the author sums up characteristics of curves which can be checked easily as an aid to plotting. Chapter 9, "Trigonometric Curves," is well done with a number of plates showing the various curves and the changes caused by a change of the variable. Chapter 11, "Polar Coordinates," is very complete, sketching many of the spirals and rose curves. There are many plates in the text and by and large they are well done. There are several reproductions, one on page 175 showing an algebraic curve of fourth degree formed by light reflection on a circular saw. The author has chosen his illustrative examples well and sets them up in a very thorough manner.

The exercises in the text are ample and nearly all lists contain one or two of special interest and difficulty. These are not at the end of the list and would need selection by the teacher. The exercises also have a practical slant and uses in everyday life, engineering, etc., are stressed. The text has continuity with references to preceding paragraphs made often in many cases restating in a more precise form the idea met originally earlier in the text. The definitions are carefully worded, but in some cases less common words have been used and these would need further explanation.

Tables of powers and roots, 1–100; common logarithms; natural logarithms; exponential functions, 1–10; trigonometric functions in angles and radians;

and a conversion table are included at the end. There are answers to odd numbered exercises in the text and answers to even numbered ones are available.

The book is well indexed. This text is more complete than most books in the field and will be welcomed by those who wish to select their course from the broader applications of Analytic Geometry.

PHILIP PEAK
University School
Indiana University

THE ED.D. DEGREE AT UNIVERSITY OF UTAH

General Requirements and Provisions for the Degree of Doctor of Education

The general procedure and regulations covering the awarding of the degree of Doctor of Philosophy also apply in awarding the degree of Doctor of Education, with certain differences, noted below, designed to provide advanced professional preparation for individuals with superior qualifications for administrative and supervisory positions in public school systems. The candidate for the degree of Doctor of Education is expected to demonstrate ability to make effective application of his knowledge to practical, professional situations. Accordingly in the distinctions below, the emphasis is placed upon the interest of professional practice rather than upon pure research. Attention is called to the desirability of pursuing studies in education towards the degree of Doctor of Philosophy in all other cases.

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